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THE TICK PROBLEM IN SOUTH AFRICA

By WILLIAM MOORE, *School of Agriculture, Potchefstroom*

One of the most important and interesting problems in Economic Entomology is the role played by ticks in the spread of certain diseases and how these ticks may be destroyed. There is probably no other country in the world where the tick problem assumes the proportion that it does in Africa. Most of the articles dealing with ticks which are available for the entomologist abroad do not consider the problem as it is presented to the entomologist and stock farmer in Africa. It is therefore—with the object of expressing the situation as it is in South Africa, that this paper is written.

Ticks and the Diseases Transmitted. In South Africa it is not one tick and one disease which must be dealt with, but a number of ticks producing a number of different diseases. *Boophilus decoloratus* Koch, the blue tick, carries Texas cattle fever (known in South Africa as redwater)—and *Spirochætosis*, the latter being a disease of cattle, horses and sheep. *Amblyomma hebræum* Koch, the Bont tick, transmits a disease of sheep, goats and cattle, known as heartwater. The organism causing the heartwater has not yet been observed, and it therefore differs from the other diseases transmitted by ticks, which are caused by Protozoa. *Hæmaphysalis leachi* Audouin, the dog tick, transmits the organism causing malignant jaundice, a rather fatal disease of dogs. *Rhipicephalus appendiculatus* Neumann, the brown tick, transmits East coast fever and gall-sickness of cattle, and may also transmit Texas cattle fever. *Rhipicephalus capensis* Koch, the Cape brown tick, transmits East coast fever. *Rhipicephalus simus* Koch, the black-pitted tick, and *Rhipicephalus evertsi* Neumann, the red tick, transmits East coast fever and gall-sickness, while *R. simus* may also transmit *Spirochætosis*, and *R. evertsi* is the carrier of biliary fever of horses.

Besides the ticks which are known to transmit diseases, there are many others which attack domesticated animals. Among these may be mentioned *Ixodes pilosus* Koch, which attacks sheep, goats, oxen, horses, etc., and is supposed to be the cause of a paralysis of sheep in Cape Colony; and *Hyalomma ægyptium* Linn., the Bont leg tick, the adult of which may be found on all domestic animals, and is thought by some to cause abscesses on the animals. Other ticks whose injury may only amount to tick worry, are *Ixodes rubicundus* Neumann, *R. oculatus* Neumann, *R. sanguineus* (Lat.), *R. lunulatus* Neumann, *R. duttoni* Neumann, *R. bursa* Canestrini & Fanzago, *R. nitens* Neumann, *Amblyomma variegatum* (Fabr.), and sometimes *A. marmoreum* Koch.

The Life History of Certain Species. With this formidable array of ticks and diseases that they transmit, it can readily be seen that their destruction is not so simple as the control of *B. annulatus* is in the Southern United States. The problem is made more difficult by the fact that the life history of the various ticks differs considerably and in some cases is such, that destruction is impossible or next to impossible. Due to the work of Doctor Theiler, C. P. Lounsbury and C. W. Howard, the life cycle of many of the common ticks has been worked out. *B. decoloratus* has a very simple life cycle. In about five days or more from the time the engorged female drops from the host, the eggs are laid. These hatch in from three to six weeks—or in winter a longer period is required. The larvæ may live for six or eight months without feeding. *B. decoloratus* seeks but one host in its life time, i.e. the moult from larva to nymph and from nymph to adult is performed without leaving the host animal. The period spent on the host is about three to four weeks. The eggs of *R. evertsi* hatch in about 30 days, and the larvæ can exist for seven months without feeding. *R. evertsi* differs from *B. decoloratus* in that two hosts are attacked in its life time. The moult from larva to nymph is performed upon the animal, but the engorged nymph drops from the animal and moults on the ground, seeking a second host for its adult existence. The time spent on the first host is about ten to fifteen days, but the adult tick may live for as much as a year, should it not find a suitable host. The adult tick remains on the host animal from six to ten days. The life cycle of *R. appendiculatus* is typical for *R. capensis, R. nitens,* and *R. simus* and is given for the group. The eggs are laid by the engorged female in about six or more days from the time she drops from the host animal. These hatch in from 28 days to several months, depending upon the temperature. The larva remains on the animal for about three to eight days, after which it too drops to the ground to moult—which is accomplished in about

21 days. The nymph attaches itself to a second host animal and remains for from two to seven days, when it drops off to moult to the adult. The second moult occupies about 18 days. The adult remains on the third host for a period of four to seven days. The larval tick can exist for seven months should it not find a host, the nymph six and one-half months, and the adult nine and one-half months. *A. hebræum* also has a life cycle much similar to *R. appendiculatus*. Three hosts are sought, the larva remains on the animal from four to 20 days, the nymph four to 20 days, and the adult 10 to 20 days.

H. ægyptium differs from the above species in that the larvæ attach themselves to various birds and hares. The larva moults to the nymph while on the bird, but the engorged nymph drops to the ground to moult to the adult. The adult attacks domesticated animals, being often very abundant upon oxen. *A. marmoreum* differs from *H. ægyptium* in that it is the larva or nymph which attacks oxen and goats, while the adult and also the nymph are very common upon tortoises.

"Trekking." Long before any relationship between ticks and disease had been discovered or even thought of, many of the Boers employed methods of ridding their flocks or herds of disease which were really based upon the distribution of the disease transmitting ticks. The High Veld is one of the farmers' favourite grazing sections of South Africa. The average altitude of the High Veld is between 4000 to 6000 feet. In the summer the land is covered with green grass, which makes very good grazing for cattle and sheep. Over this area the ticks which transmit diseases are limited or nearly limited to *B. decoloratus* and *R. evertsi*. The reason for this is that the group of brown ticks and the Bont tick cannot withstand the temperature. In the winter the grass dries up and the pasture becomes poor, so the stock farmers started the practice of "trekking" or traveling with their animals to the warm low veld or bush veld, where the grass was abundant. There their animals often took sick from some of the "tick diseases"—especially was this true with the approach of the hot weather. The Boers would then trek back to the higher country, and upon reaching a place where the ticks which caused the disease could no longer live, the disease would disappear.

Grass Burning. Grass burning is another early method which was and is even yet often employed to reduce the number of ticks. By burning off the dry grass, the new green grass comes up much sooner and will furnish grazing for cattle and sheep at a much earlier date. Some farmers noticed that after the grass had thus been burned off, the animals suffered far less from ticks. The practice of grass

burning then came to be adopted against the ticks themselves. Burning off the grass, when the larvæ ticks are sitting on it waiting for a host animal, will greatly reduce the number of ticks, but of course fails to destroy the ticks or tick eggs which are in a protected position.

Starvation of Ticks. The starvation method of eradicating ticks —which has been so successful in the Southern United States, against *B. annulatus* has been tried in South Africa, but has not been so effective. If *B. decoloratus* was the only tick which was to be starved out, the method would prove successful in this country, providing all the host animals were kept off the land for a period of nine to ten months. The animals would all be moved into plot B and at the

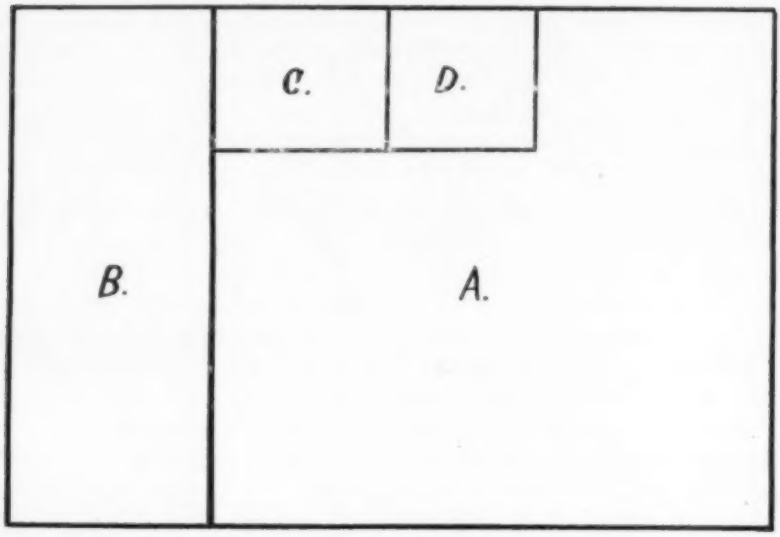

Fig. 6. Plan showing division of land for the starvation of ticks.

end of nine or ten months moved to plot C for a period of about five or six weeks, during which time all the ticks would have dropped from the animal, but they would not have time to lay their eggs, and the larvæ of the next generation to attach themselves to the animals. The stock could then be turned into A which would be tick-free, while B and C could be closed to cattle for ten months.

Generally the question is not the eradication of the blue tick, but also the eradication of the brown and red ticks, *Rhipicephalus* sps. and the Bont tick *A. hebræum*. In theory even these could be destroyed by placing all the animals in B and keeping them there for a period of fifteen months. They could then be transferred to C where they could be kept for about six weeks and the blue tick

would fall off, as stated above. From the facts given, however, it will be seen that within four weeks the larvæ and nymphæ which have dropped from the cattle when they were first moved into C will have moulted to the succeeding stages and be again found on the cattle.

Therefore it is advisable to move the cattle at the end of 18 days to a new plot D so that the ticks which have dropped off in C will not have had time to moult and again seek the host. In D the remainder of the ticks on the animals will drop off and in 18 days the animals tick-free could be turned into A. B, C, and D could be closed against cattle for 14 to 16 months and the farm thus freed of ticks. This method in theory would rid the farm of all the ticks which are known to transmit diseases to oxen, horses, sheep and goats.

In practice however the starvation of ticks is not so easy, due to the number of wild animals which will act as hosts to the ticks, thus carrying them over the starvation period.

The following table of the common ticks, which will attach themselves to some of the common wild animals, will show how easily the tick can be carried over the "starvation period":—

COMMON AFRICAN TICKS AND THEIR WILD HOSTS

Hosts	*A. hebræum*	*B. decoloratus*	*R. appendiculatus*	*R. capensis*	*R. evertsi*	*R. simus*
Lion	X	..	X	..	..	X
Wild Dog	X	..	..	..	..	X
Jackal	..	..	..	..	..	X
Reed Buck	..	..	..	..	X	..
Various Antelopes	X	..	X	..	X	..
Buffalo	X	..	X	..	..	..
Giraffe	X	..	..	..	X	..
Bush Pig	..	..	..	..	..	X
Cape Hare	..	..	X	..	X	..
Hedgehog	..	..	..	..	..	X
Ostrich	X	..	..	..	..	..

This table compiled from the work of C. W. Howard, shows that of those ticks which transmit disease but two species do not find a host on the wild animals. In an actual trial of the starvation method carried out by H. E. Laws in the East London district, the results obtained are very nearly what one would expect from the above. A portion of a farm was closed to all stock in May 1908. In February, 1911, ten oxen were driven to the gate of the enclosed farm, and after all the ticks which could be found were picked off, they were thoroughly sprayed with a mixture of kerosene and water containing 25 percent

of kerosene. The oxen were then turned into the paddock and allowed to remain for three days. The animals were then carefully examined and all the ticks collected, numbering 340 in all. The results may be conveniently tabulated.

TICKS COLLECTED FROM TEN OXEN

	Males	Females	Nymphs	Total
A. hebræum	6	..	1	7
Ixodes pilosus	2	9	..	11
R. simus	73	176	1	250
R. evertsi	8	3	..	11
R. appendiculatus	27	15	2	44
R. capensis	5	8	..	13
Hæmaphysalis parmata (?)	..	4	..	4

From this experiment it will be seen that the blue tick can be starved, but it also shows that *R. capensis* seems to have some host among wild animals which has not been observed. Mr. Laws does not state what wild animals may have been running on this area other than hares and duiker (one of the antelopes)—both of which he mentions as being tick infested when shot.

Not all farmers have all the animals mentioned above, but hares and antelopes are very abundant. Many farms have hundreds or thousands of various antelopes which are not free to be shot even should the farmers so desire. With these conditions it does not seem likely that even the ticks which transmit diseases will be eradicated by the starvation method. *Hæmaphysalis leachi*, the tick which carries malignant jaundice, will probably never be eradicated, as dogs cannot be so readily handled as stock, while ticks such as *Hyalomma ægyptium* cannot be reduced to any great extent, as the birds will be constantly reinfesting the farm.

In favour of the starvation method, Dr. Theiler mentions that the freeing of an area from East coast fever is probably due to the starving out of the ticks. He does not mention that the ticks entirely disappeared, but that the area was freed from East coast fever by the removal of the stock for about 15 months. Inasmuch as the organism causing East coast fever does not remain in the blood of the recovered animal, and as the tick cannot transmit the disease after it has attached itself to an animal which does not have the disease, it would seem that the freeing of these areas from East coast fever was not the starvation of the ticks, but the freeing of the ticks of the organisms causing the disease.

Dipping. The usual and the most successful method employed in South Africa against ticks is dipping. A large trough is used through which the cattle are made to swim. A fenced passage which is divided several times by gates, leads up to the entrance of the dipping tank. By means of gates the number of animals approaching the dip can be regulated until only one passes into the dip at a time. A steep incline causes the animal to slip into the dipping fluid through which it swims to the other side, which is furnished with steps by which the animal can easily climb out.

There are a number of patent dipping fluids on the market, but the one found most useful is that recommended by Pitchford, which is

5 1-2 lbs. of soft soap.
2 gallons kerosene.
8 1-2 lbs. arsenite of soda.
400 gallons of water.

Even dipping has its disadvantages, if the farmer has many species of ticks which he is desirous of destroying. If only *B. decoloratus* is to be destroyed, dipping every three weeks will catch all the ticks, which attach themselves to the animal. *R. evertsi*—as is seen from the life cycle, only remains on the animal for a period of six or ten days as an adult. In order therefore to destroy all which may attach themselves—the dipping would have to be done every week. If the farmer also wishes to destroy the brown ticks, *Rhipicephalus* sps.—he would need to dip every three days to insure killing every tick which would attach itself to his animals. In order to make dipping every three days possible, the above formula has been modified to:

3 lbs. soft soap.
1 gal. kerosene.
4 lbs. arsenite of soda (20 percent arsenic).
400 gals. water.

Where wild animals are abundant on the farm, (they may far outnumber the stock animals)—the chances are that many ticks will be carried along upon them and never be destroyed by the dip. Heavy stocking the farm and frequent dipping however will greatly reduce the number of ticks. Where the farmer has his cattle grazing over one or two thousand acres, and must collect these and drive them through the dip every three days, it is found that it seriously interferes with any other farming operations in which he is engaged. It would seem, however, that, should dipping be done every week, although all the ticks which would attach themselves to the animal would not be killed, still by the law of chance, ticks which escaped the dip at one

time would be caught at a later date providing the dipping was continued over a number of years.

Conclusion. From the above brief account of the work which has been done and is being done, in South Africa, it will be seen that—although the tick problem is a large one, much has been accomplished. It is now for the farmer to put into practice what has been learned of the ticks and the methods of their eradication. Many progressive farmers have built dipping tanks and are regularly dipping their cattle. There are still many who have not yet adopted good methods of ridding their farms of ticks, but it is to be hoped that soon, by a united effort, the farmers will at least reduce the number of species of ticks which annually cause them loss.

THE EGG LAYING HABITS OF ADOXUS VITIS IN FRANCE

By C. R. Crosby

In speaking of the egg laying habits of the California grape rootworm (*Adoxus obscurus vitis*) H. J. Quayle (Calif. Agr. Exp. Station, Bull. 195, p. 11, 1908) states, "The eggs of this beetle are laid usually in crevices beneath the layers of bark on the old wood. . . . The same insect in France, according to Mayet, lays in the neighborhood of thirty eggs either singly or in patches on the under side of the leaves. This number is probably simply an approximation. The fact, if it is a common occurrence, that they are laid on the under side of the leaves, is the most striking difference between the habits in California and in France." In a footnote Quayle cites, Mayet's *Insectes de la Vigne*, p. 308, as authority for this statement.

This is certainly a striking difference of habit and out of curiosity the writer consulted Mayet's work and found on page 308 a statement to that effect but also discovered that it did not refer to *Adoxus vitis* at all but to *Altica ampelophaga*. On page 326 Mayet describes the egg laying habits of Adoxus as follows: "Le nombre des œufs pondus est d'une trentaine environ; ils sont deposés, en captivité, dans les anfractuosités et les fentes du recipient où on élève l'insecte, les replis de papier, etc. Il est probable qu'à l'etat de liberté ils sont toujours placés sons les écorces, non ioin du collet de la souche; c'est dans conditions—la M. Maurice Giard dit avoir observé plusieurs poutes." This agrees closely with the habits of the beetle in California as described in detail by Mr. Quayle.

LIME-SULPHUR WASH AN INEFFICIENT OVICIDE FOR CODLING MOTH

By V. I. Safro, *Oregon Agricultural College, Corvallis, Oregon*

Reports have occasionally been published showing a decrease in codling moth infestation following applications of a lime-sulphur wash. Until within the past few years a coating of lime-sulphur upon insect eggs has generally been considered fatal. Only recently have experiments shown a surprising lack of insecticidal power in spraying aphid and red spider eggs with lime-sulphur mixtures.

The Oregon Station, and doubtless other stations, has received letters from growers claiming a reduction in codling moth infestation due to applications of lime-sulphur. One grower even stated that summer applications alone of lime-sulphur had kept the crop practically free from codling moth.

This is a report of a short preliminary series of experiments conducted during the fall of 1911, in order to obtain data on the possible efficiency of lime-sulphur in killing the eggs of the codling moth. From an infested orchard, more than two hundred apples were collected upon which codling moth eggs had been deposited.[1] These were examined and only the apparently healthy eggs were used in the experiment.

Method of Facilitating Daily Observations. The small size of the eggs and their inconspicuous color rendered their necessarily frequent location and examination a rather slow process. A simple method was devised that resulted in but a minimum loss of time in locating eggs.

The side of the apple opposite the egg was cut to form a flat base. Each apple, then, rested on this base with the egg (where but one was present) on top. To still further facilitate location of the eggs and provide for the ready location of several eggs on one apple, an arrow was cut in the epidermis pointing to and but about one-fourth of an inch from the egg. The arrow, upon exposure to the air, turned brown and became quite prominent. It is interesting to note that the arrow was a very convenient place for the recently hatched larva to begin feeding. In fact, in almost every case, the young larva was found feeding in the arrow. Each apple was placed upon a slip of paper which bore the number of the apple and other data.

Conditions of the Experiment. The experiments were carried on

[1] Of the 221 apples collected, 198 had one egg each, 20 had two eggs each, one had three, and two had four eggs. In four cases the two eggs present on an apple were partly superimposed, indicating two successive eggs from the same moth.

in a laboratory, the infested apples being placed upon desks safe from the direct rays of the sun. The daily maximum temperature of the room during the tests ranged from 64° F. to 71° F. All eggs were examined at least once a day and the appearance recorded.[1] The maximum temperature outdoors ranged from 55° F. to 72° F.

On September 24th all eggs that had failed to hatch were examined to ascertain, if possible, the condition of the embryo at death. When the embryo appeared hard and dry it was recorded as "dried." When the contents of the egg were watery the egg was recorded as "crushed." This was undoubtedly the case in some instances but the term is used in the absence of a certain knowledge of the cause of death. Embryos apparently normal but in which the development ceased before hatching was complete were recorded as "dead." These terms are indefinite and signify nothing more than merely the appearance of the egg contents.

At first an attempt was made to spray the apples by means of an atomizer. This method was given up as a failure because the spray collected in drops covering only a small portion of the surface of the apple, in which case the egg was more frequently missed than hit. When the drops of spray were too large they would roll from the apple leaving a practically dry surface. The same would frequently occur upon shaking the fruit. This was the first indication in the experiment of the inefficiency of a lime-sulphur spray for killing codling moth eggs. The failure of a spray to cover the eggs deposited on the fruit is sufficient to exclude it as a codling moth ovicide regardless of its efficiency in the laboratory.

The method adopted was to place a drop of the spray material directly upon the egg. If, then, with such treatment the insecticide failed, then the results would be doubly conclusive.

The eggs were divided into four lots. One lot remained untreated as a check. A second lot received a treatment of a one-to-30 dilution of lime-sulphur testing 30° B.[2] A third lot received lime-sulphur

[1] The appearance of the well known "red ring" and "black spot"; when the larva was visible throught the chorion with a hand lens the appearance was recorded as "larva."

[2] The author frankly admits that this specification of the "strength" of lime-sulphur, so often encountered in the literature, signifies absolutely nothing. It is true that the dilution is certain and known and if a *chemically identical* lime-sulphur concentrates were diluted similarly then the *biological* results would, under similar conditions, be similar. But all 30° B. lime-sulphurs are by no means identical or even approximately so. Nor does it make matters any clearer to obtain an analysis showing the amount of total sulphur or total sulphid sulphur. Such data give no more definite idea of its efficiency as an insecticide (or, for that matter, as a fungicide) than a mere statement of its density. The reason for this uncertainty lies in the

one to 30 with arsenate of lead added at the rate of four pounds to 100 gallons of the diluted spray. The fourth lot was treated with a 5% solution of calcium polysulphides containing a slight amount of CaS_2O_3, furnished by Prof. H. V. Tartar, of the Oregon Experiment Station. The eggs were treated on the day collected.

Results with Unsprayed Apples. As a check, ninety-three eggs were left untreated in the laboratory. Of these, ninety hatched, one was accidentally crushed and two failed to hatch "due to natural causes."

Notes on the Appearance of the Developing Eggs. It was noted, in recording the appearance of the eggs, that of the twenty-six white eggs in the lot, only five showed a red ring before the appearance of the black spot. The eggs recorded as having a red ring showed all variations from the merest trace of red to a deep red circle, many showing but fractional rings. In one case (35 a) the egg hatched without the black spot becoming visible through the chorion. Additional data in the tables are included as records on development.

Lime-sulphur Wash (30° B.) 1–30. One hundred eggs were treated with a one-to-30 dilution of clear lime-sulphur testing 30° B. Of this number 85 hatched, one was accidentally killed and 14 failed to hatch due to other causes. This fourteen percent includes, undoubtedly, some "natural" and "accidental" mortality. Deducting these latter items—or even ignoring them—the lime-sulphur mortality amounts to very little indeed. Were every codling moth egg in an orchard hit

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fact that a specific gravity determination of a lime-sulphur solution is really a reading of two (at least) solutions of unknown densities, present in unknown proportions, and of radically different degrees of chemical activity. These two solutions are the calcium polysulphides (CaS_4 and CaS_5) and the calcium thiosulphate (CaS_2O_3). Of these solutions the polysulphides are by far the most active, chemically, and undoubtedly the most important insecticidal ingredient in lime-sulphur.

The length and rapidity of boiling and cooling the spray are important factors causing the variation in proportion of calcium thiosulphate to the calcium polysulphides, the proportion of polysulphides increasing with the length of boiling and the thiosulphates increasing with the rapidity of cooling. The knowledge of the resulting density of the solution gives no definite idea of its chemical nature. Of the two solutions, the one lower in density may be much more active due to the larger amount of polysulphides present in proportion to the thiosulphate. For the same reason a dilution of one concentrate may be fully as effective as a "stronger" dilution of another. The bearing of this problem on the occurrence of spray injury to the foliage is discussed by the author in a forthcoming publication.

The nearest approach, at present, to a logical determination of the "strength" of lime-sulphur is a statement of the amounts present of calcium polysulphide and calcium thiosulphate. The author used a 5% solution of calcium polysulphide as a more certain test in addition to "a one-to-30 dilution of lime-sulphur testing 30° B."

UNTREATED EGGS, DETAIL TABLE

No. of apple	Collected		Subsequent appearance					Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
16 a	9	white	10	black spot	11	larva		12	3
40 a	9	white	10	black spot				12	3
49 a	10	white	11	black spot				13	3
60 a	10	white	11	black spot	12	larva		13	3
62 a	10	white	11	black spot	12	larva		13	3
52 a	10	white	12	black spot				14	4
7 a	9	white	12	black spot	13	larva		14	5
33 a	9	white	12	black spot	13	larva		14	5
59 a	10	white	14	black spot				16	6
44 a	10	white	16	black spot				18	8
1 a	9	white	16	black spot	17	larva		18	9
3 a	9	white	10	red ring	17	black spot		18	9
6 a	9	white	16	black spot				18	9
9 a	9	white	17	black spot				18	9
41 a	9	white	10	black spot	17	larva		18	9
68 a	10	white	11	red ring	18	black spot		19	9
2 a	9	white	17	black spot	18	larva		19	10
14 a	9	white	17	black spot	18	larva		19	10
21 a	9	white	14	red ring	18	black spot		19	10
22 a	9	white	17	black spot	18	larva		19	10
56 a	10	white	18	black spot	19	larva		20	10
73 a	10	white	12	red ring	19	black spot		20	10
81 a	10	white	11	red ring	18	black spot		20	10
82 a	10	white	19	black spot				30	10
79 a	10	red ring	11	black spot				12	2
15 a	9	red ring	10	black spot	11	larva		12	3
19 a	9	red ring	10	black spot				12	3
23 a	9	red ring	11	black spot				12	3
24 a	9	red ring	10	black spot				12	3
29 a	9	red ring	10	black spot				12	3
35 a	9	red ring	11	black spot				12	3
35 a	9	red ring						13	3
46 a	10	red ring	11	larva				13	3
51 a	10	red ring	11	black spot	12	larva		13	3
54 a	10	red ring	11	black spot				13	3
58 a	10	red ring	11	black spot	12	larva		13	3
66 a	10	red ring	11	black spot	12	larva		13	3
69 a	10	red ring	12	larva				13	3
71 a	10	red ring	11	black spot				13	3

UNTREATED EGGS, DETAIL TABLE—*Continued*

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
4 a	9	red ring	11	black spot				13	4
13 a	9	red ring	11	black spot				13	4
41 a	9	red ring	12	black spot				13	4
55 a	10	red ring	13	black spot				14	4
64 a	10	red ring	12	black spot				14	4
67 a	10	red ring	13	black spot				14	4
74 a	10	red ring	12	larva				14	4
80 a	10	red ring	12	black spot				14	4
5 a	9	red ring	12	black spot				14	5
12 a	9	red ring	12	black spot	13	larva		14	5
31 a	9	red ring	12	black spot	13	larva		14	5
34 a	9	red ring	12	black spot	13	larva		14	5
36 a	9	red ring	12	black spot				14	5
38 a	9	red ring	13	black spot				14	5
42 a	9	red ring	12	black spot				14	5
17 a	9	red ring	14	larva				15	6
18 a	9	red ring	10	black spot	11	larva		15	6
20 a	9	red ring	13	black spot	14	larva		15	6
26 a	9	red ring	13	black spot	14	larva		15	6
27 a	9	red ring	14	larva				15	6
43 a	10	red ring	14	black spot				16	6
61 a	10	red ring	14	black spot				16	6
76 a	10	red ring	14	black spot	15	larva		16	6
77 a	10	red ring	16	black spot				17	7
24 a	9	red ring	15	black spot				17	8
39 a	9	red ring	15	black spot				17	8
48 a	10	red ring	17	black spot				18	8
50 a	10	red ring	16	black spot				18	8
11 a	9	red ring	17	black spot				18	9
37 a	9	red ring	16	black spot				18	9
47 a	10	red ring	17	black spot				19	9
65 a	10	red ring	17	larva				19	9
75 a	10	red ring	18	black spot				19	9
78 a	10	red ring	18	black spot				19	9
4 a	9	red ring	14	larva			crushed	24	
5 a	9	black spot						10	1
5 a	9	black spot						10	1
25 a	9	black spot						10	1
28 a	9	black spot						10	1
30 a	9	black spot						10	1
32 a	9	black spot						10	1
44 a	10	black spot						11	1
45 a	10	black spot						11	1
53 a	10	black spot						11	1
63 a	10	black spot						11	1
70 a	10	black spot						11	1
72 a	10	black spot						11	1
74 a	10	black spot						11	1
83 a	10	black spot						11	1
10 a	9	black spot						12	3
57 a	10	black spot					crushed	11	
65 a	10	black spot	12	larva			dried	17	

LIME-SULPHUR WASH (30° B.) 1–30, DETAIL TABLE

No. of apple	Collected		Subsequent appearance					Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
63 b	10	white	11	black spot				12	2
67 b	10	white	11	larva				13	3
71 b	10	white	12	black spot				13	3
38 b	9	white	12	larva				13	4
66 b	10	white	13	black spot				14	4
51 b	10	white	14	black spot	15	larva		16	6
15 b	9	white	16	black spot				17	8
24 b	9	white						17	8
58 b	10	white	16	black spot				18	8
9 b	9	white	10	red ring	17	larva		18	9
43 b	9	white	16	black spot				18	9
50 b	10	white	16	black spot				19	9
68 b	10	white	16	black spot	18	larva		19	9
7 b	9	white	18	larva				19	10
21 b	9	white	17	black spot				19	10
25 b	9	white	14	red ring	17	black spot		19	10
28 b	9	white	17	black spot				19	10
30 b	9	white	17	black spot				19	10
54 b	10	white	19	black spot				20	10
71 b	10	white	18	black spot				20	10
72 b	10	white	19	black spot				21	11
71 b	10	red ring	12	black spot				12	2
72 b	10	red ring	11	black spot				12	2
78 b	10	red ring	11	black spot				12	2
5 b	9	red ring	10	black spot				12	3
11 b	9	red ring	11	black spot				12	3
16 b	9	red ring	10	black spot				12	3
18 b	9	red ring	10	black spot	11	larva		12	3
20 b	9	red ring	10	black spot	11	larva		12	3
32 b	9	red ring	10	black spot				12	3
48 b	10	red ring	11	black spot	12	larva		13	3
49 b	10	red ring	11	black spot	12	larva		13	3
53 b	10	red ring	11	black spot				13	3
55 b	10	red ring	11	black spot	12	larva		13	3
56 b	10	red ring	11	black spot	12	larva		13	3
57 b	10	red ring	12	black spot				13	3
71 b	10	red ring	12	black spot				13	3
75 b	10	red ring	11	black spot				13	3
81 b	10	red ring	12	black spot				13	3
84 b	10	red ring	11	black spot	12	larva		13	3
1 b	9	red ring	11	black spot	12	larva		13	4
3 b	9	red ring	10	black spot	12	larva		13	4
12 b	9	red ring	12	black spot				13	4
19 b	9	red ring	11	black spot	12	larva		13	4
29 b	9	red ring	11	black spot	12	larva		13	4

LIME-SULPHUR WASH (30° B.) 1-30, DETAIL TABLE—*Continued*

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
30 b	9	red ring	11	black spot	12	larva		13	4
45 b	10	red ring	10	black spot	12	larva		13	4
47 b	10	red ring	11	black spot	12	larva		14	4
65 b	10	red ring	13	black spot				14	4
69 b	10	red ring	13	black spot				14	4
79 b	10	red ring	13	black spot				14	4
87 b	10	red ring	12	larva				14	4
4 b	9	red ring	12	black spot	13	larva		14	5
26 b	9	red ring	11	black spot	12	larva		14	5
31 b	9	red ring	12	black spot				14	5
42 b	9	red ring	12	black spot				14	5
82 b	10	red ring	13	black spot	14	larva		15	5
2 b	9	red ring	13	black spot	14	larva		15	6
6 b	9	red ring	13	black spot	14	larva		15	6
46 b	10	red ring	14	black spot	15	larva		16	6
74 b	10	red ring	14	black spot				16	6
10 b	9	red ring	13	black spot	14	larva		16	7
14 b	9	red ring	13	black spot	14	larva		16	7
41 b	9	red ring	13	black spot				16	7
70 b	10	red ring	11	black spot	14	larva		17	7
76 b	10	red ring	13	black spot				17	7
83 b	10	red ring	14	black spot	16	larva		17	7
34 b	9	red ring	16	black spot				17	8
76 b	10	red ring	13	black spot				18	8
86 b	10	red ring	16	black spot				18	8
17 b	9	red ring	16	black spot	17	larva		18	9
27 b	9	red ring	15	black spot				18	9
62 b	10	red ring	16	black spot				19	9
61 b	10	red ring	18	larva				20	10
8 b	9	red ring					dried	10	
20 b	9	red ring	11	black spot	12	larva	dried	24	
22 b	9	red ring					dried	17	
47 b	10	red ring	12	black spot	13	larva	dried	24	
53 b	10	red ring	12	black spot			dried	24	
65 b	10	red ring	16	black spot			dead	24	
76 b	10	red ring	16	black spot			dead	24	
77 b	10	red ring	14	black spot			dried	24	
36 b	9	black spot						10	1
44 b	9	black spot						10	1
63 b	10	black spot						11	1
76 b	10	black spot						11	1
77 b	10	black spot						11	1

LIME-SULPHUR WASH (30° B.) 1-30, DETAIL TABLE—*Continued*

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
33 b	9	black spot						11	2
39 b	9	black spot						11	2
40 b	9	black spot						11	2
40 b	9	black spot	11	larva				14	5
23 b	9	black spot					dried	24	
35 b	9	black spot	11	larva			crushed	24	
37 b	9	black spot	11	larva			crushed	24	
59 b	10	black spot	11	larva			dried	24	
60 b	10	black spot					dried	24	
85 b	10	black spot	10	larva			dried	24	
80 b	10	larva					dried	24	

and covered by the spray (which is impossible practically) the largest percent mortality according to these results would be about 14 percent. In view of the fact that a foliage spray must be used when spraying for codling moth eggs, a one-to-30 dilution of a clear lime-sulphur solution is about as "strong" as would ordinarily be used. This preliminary experiment demonstrates to our satisfaction the ineffectiveness of lime-sulphur as a codling moth ovicide.

Notes on Development. In this lot, of twenty-one white eggs only two showed the red ring before the appearance of the black spot. Almost all eggs with a red ring when collected showed the black spot before hatching.

All the white eggs hatched. Of the sixty-three eggs with whole or fractional red rings when collected, eight, about 13 percent, failed to hatch. Of fifteen eggs showing the black spots when collected, six, 66 2-3 percent, failed to hatch. These records seem to indicate that the eggs are killed later on in their development—at a period when the embryo requires the most oxygen. Of the fifteen dead eggs the fully developed embryo, recorded as "larva," was visible through the chorion in eight. The embryo may have been as fully developed in the other eggs but on account of the residue of the spray or the opacity of the chorion could not be seen.

Lime-sulphur Wash (30° B.) 1–30 and Lead Arsenate 4–100. Would the addition of the usual strength (4 pounds in 100 gallons) of lead arsenate be effective in preventing the eggs from hatching? To obtain data on this question a third lot of twenty-three eggs were treated.

Of these, sixteen hatched, the larvæ all surviving. Taking for granted that the seven failing to hatch were killed by the treatment still the survival amounted to about 70 percent, indicating the futility of spraying with lime-sulphur and lead arsenate to prevent hatching of the eggs.

LIME-SULPHUR WASH (30° B.) 1-30 AND LEAD ARSENATE 4-100, DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		S.pt.				
5 d	11	white	20	black spot				21	10
12 d	11	white	20	black spot				21	10
1 d	11	red ring						19	8
6 d	11	red ring	19	black spot				20	9
11 d	11	red ring	19	black spot				20	9
18 d	11	red ring	18	black spot				20	9
2 d	11	red ring						21	10
7 d	11	red ring					dead	24	
15 d	11	red ring					dried	24	
22 d	11	red ring	15	black spot			crushed	24	
23 d	11	red ring	18	black spot			dead	24	
24 d	11	red ring	16	black spot			dead	24	
9 d	11	black spot						13	2
17 d	11	black spot						13	2
20 d	11	black spot						14	3
21 d	11	black spot	13	larva				14	3
10 d	11	black spot						15	4
16 d	11	black spot						15	4
3 d	11	black spot						16	5
19 d	11	black spot						19	8
8 d	11	black spot					crushed	24	
14 d	11	black spot					dead	24	
4 d	11	larva						14	3

Calcium Polysulphides (5 percent Solution). The lime-sulphur used in the previous experiments was undoubtedly, to some extent, the cause of the death of the embryo. In order to obtain some data

on the possible effect of the stronger, more accurately known, solution twenty-eight eggs were treated with a 5 percent solution of calcium polysulphides. This strength is equivalent to a lime-sulphur dilution of about one to eight, more or less, depending upon many factors. Of the twenty-eight eggs treated, eight hatched. The twenty failing to hatch included probably some natural mortality. In all results

FIVE PER CENT CALCIUM POLYSULPHIDES, DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
23 e	11	white						21	10
7 e	11	white					crushed	24	
10 e	11	white	12	black spot			dead	24	
11 e	11	white					dead	24	
13 e	11	white					dead	24	
16 e	11	white					crushed	24	
17 e	11	white					dead	24	
26 e	11	white					crushed	24	
12 e	11	red ring						12	1
18 e	11	red ring	13	black spot				15	4
2 e	11	red ring	13	black spot	14	larva		16	5
20 e	11	red ring	12	black spot				16	5
28 e	11	red ring						17	6
30 e	11	red ring	15	black spot	16	larva		17	6
3 e	11	red ring	17	black spot	18	larva		19	8
5 e	11	red ring					crushed	24	
15 e	11	red ring					dead	24	
19 e	11	red ring					dead	24	
22 e	11	red ring	14	black spot			crushed	24	
24 e	11	red ring	16	black spot			dead	24	
25 e	11	red ring					dead	24	
27 e	11	red ring	18	black spot			dead	24	
1 e	11	black spot					dried	24	
4 e	11	black spot					crushed	24	
9 e	11	black spot					dead	24	
14 e	11	black spot	15	larva			dead	24	
6 e	11	larva					dried	24	
29 e	11	larva					dead	24	

of this kind it should be remembered that the number of eggs hatched is of much greater importance than the number failing to hatch. With these results, then, it is evident that lime-sulphur, even too strong for use on foliage and fruit is, at best, an uncertain ovicide, its effectiveness of doubtful value economically.

WOOLLY APHID MIGRATION FROM ELM TO MOUNTAIN ASH[1]

Schizoneura lanigera (*americana*)

By Edith M. Patch

In the vicinity of Orono, the woolly aphid of the apple, *Schizoneura lanigera*, was abundant during the late summer and autumn of 1911 upon water shoots of certain apple trees; and upon trunk and branches of native mountain ash, *Pyrus* (*Sorbus*) *americana*; cultivated ornamental species of mountain ash, *Pyrus sitchensis* and others; and native and cultivated species of hawthorn, *Cratægus*. Some of each of these trees were located with the view of studying the overwintering forms of this aphid, some of which, according to all published accounts, migrate up from the base of the tree in the spring to tender and susceptible places on the bark where they establish bark feeding colonies. No such occurrence, however, took place here the spring of 1912. The identical trees which were heavily infested with woolly aphid last fall were free from infestation this spring until late in June and then the infestation did not come from root aphids. Whether *lanigera* ever overwinters on the apple in this climate one season's observations are of course insufficient to ascertain. I had heretofore taken it for granted that it would do so and this point has not been previously investigated in this locality. Testimony as to this habit is desirable from other northern states and I shall plan to continue observations here for some years to come. It should be stated that these notes concern the trunk, branches and water shoots only; no roots being examined. If, however, root forms were present they and their progeny certainly remained buried this spring, as daily observations of selected trees were made. It seems not improbable that the hard packed condition of the clay soil in this immediate vicinity may be partly responsible for this circumstance. The fall migrants of this colony were mature and taking flight September 20–23.

[1] Papers from the Maine Agricultural Experiment Station: Entomology No. 59.

Through the kindness of several southern entomologists, elm leaf curl in considerable abundance with winged forms ready for migration was secured in May. These migrants as previously explained (Science, Vol. 36, pp. 30–31) were caged over apple seedlings greenhouse-grown for the purpose, the seeds having been planted in December 1911 and January 1912. A few very successful colonies of woolly aphids were thus established on apple seedlings by the progeny of the elm migrants, the earliest of which was one started by migrants received May 12 which is still flourishing, even in indoor conditions, at the time this paper goes to press.

Encouraged by the successful indoor tests,[1] outdoor tests under more favorable conditions were made when the winged forms appeared in this vicinity.

Water shoots had been allowed to grow about the base of a mountain ash, *Pyrus sp.* on the campus and up to June 21 this tree and the shoots were free from woolly colonies. As the migrants are much more docile about sundown than earlier in the day, I placed several hundred elm migrants at the base of the water shooots, about 7 p. m. on June 21. They moved about a little, most of them creeping to the ventral side of a leaf and remaining there; and during the night producing nymphs which sought the leaf axils of the water shoots so that by the afternoon of June 22 the tiny nymphs had already fed enough and secreted enough white wax to give the typical "woolly" appearance to the colonies. These and their progeny thrived on the mountain ash in a perfectly normal way for the woolly aphid of the apple.

Similar successful results were obtained by evening "plantings" of elm migrants upon uninfested water shoots of apple on June 24.

By this time the elm curl migrants were settling of their own accord on leaves of both mountain ash and apple and by June 28 colonies of

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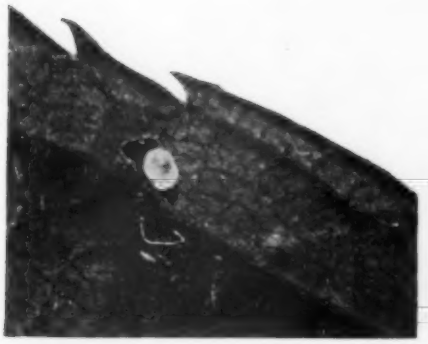
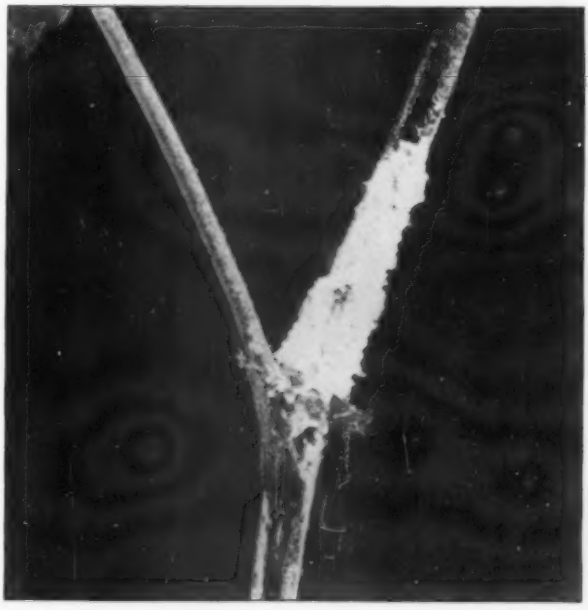
[1] A very high percent of the indoor attempts to establish colonies upon apple seedlings, both with the material from the south and with Maine collections were unsuccessful. The reasons for the failures I do not know. The seedlings were grown from seeds removed from apples on the Maine market and it is possible that many of these plants were varieties not susceptible to attack. Though healthy, the seedlings were rather a scrubby lot, having received no fertilizer on the theory that "neglected orchards suffer worst from attacks of woolly aphids." The later outdoor experiments showed that the most vigorously growing water shoots of apple and mountain ash (*Pyrus*) were most readily accepted, which would indicate that if the seedlings had been forced as they are in the nursery they might have been better bait. I think, too, that freshly moulted migrants are often too restless and instinctively impelled to flight and dispersal to take kindly to confinement. Whatever the trouble, I have often had cause to recall Riley's remark on this species,—"There is much greater difficulty in fully tracing the life-history of one of these small creatures than might be supposed. They languish in confinement and ill bear handling."



1. *Metellus rubi*, egg blister, one opened to show the egg and the one at the right intact.



2. Nymphs of the Woolly Aphid, *Schizoneura lanigera* (*americana*), on mountain ash, *Pyrus americana*,—the immediate progeny of migrants from elm leaf curl. Photographed at Orono, June 28, 1912.

nymphs of woolly aphid were easily found on both these summer hosts. That these were the progeny of the elm leaf migrants there was evidence enough. One native mountain ash, *Pyrus americana*, will serve for an illustration. The main trunk of this tree was dead nearly to the ground, but twelve vigorous shoots had grown up measuring about five feet each. On June 28 this mountain ash had about 150 woolly masses of nymphs grouped on the stem at the leaf axils. These nymphs ranged from very tiny ones to half grown insects, none being mature at that date. One such woolly mass contained 155 individuals of various sizes. (See plate 10, figure 2.) On the ventral surfaces of the leaves of this mountain ash were stationed many elm leaf migrants producing there their broods of nymphs which could be seen, with the hand lens, to be augmenting the woolly masses on the stem. Collections of these migrants thus stationed were made as follows:—July 2, 88 migrants; July 3, 211 migrants; July 5, 92 migrants; July 8, 54 migrants; July 9, 80 migrants; July 10, 33 migrants; July 11, 14 migrants; July 12, 3 migrants. Only living individuals were collected, dead ones being brushed off and discarded in the counts. Microscopic examination showed them to be identical with winged forms collected in elm leaf curls. Two large elm trees with leaves well stocked with this species stood about a rod distant.

Correlated with the appearance of the stem colonies of woolly aphides on mountain ash (*Pyrus* sp.) and water shoots of apple which were definitely ascertained to be the progeny of elm leaf migrants, were woolly bark feeding colonies on the trunks and branches of the elm, *Ulmus americana*. These were mostly about pruning wounds or protected under the bark, the latter colonies often not visible except on scaling back the bark. That these bark colonies on the elm are also the progeny of elm leaf migrants I have no doubt; but as the chief point of interest this year was centered in watching the elm leaf-apple situation no real attempt was made to get at the elm leaf-elm bark situation by catching the bark colonies in the process of making. This should not be especially difficult to do and is listed among the plans for 1913. In this connection it should be remembered that Riley's classic work on this species gives a continuous cycle for the elm in which he states of the *fourth generation* (progeny of the winged generation developing in the leaves): "They are, however, able to sustain themselves on the tender bark of twigs alone, and may be found nearly fully-grown, there exposed to view and enveloped in the white cottony matter, which brushes off at the slightest touch."

What influences the destination of the elm-leaf migrants and what determines their choice of the summer food plant for their progeny is not known. That they readily accept elm bark under some conditions

Riley's account testifies. That they migrate to water shoots of apple; to mountain ash (*Pyrus* species) and to hawthorns (*Crataegus* species), there producing progeny known as the woolly aphid of the apple, I have had definite and repeated proof.

The woolly colonies (mostly hidden under rough bark) are this season more abundant upon the elm than upon the apple in this vicinity, comparatively few of the apples being colonized, the mountain ash being here conspicuously a favorite summer host for *Schizoneura lanigera* (*americana*).

A bulletin of the Maine Agricultural Experiment Station (No. 203) now in press treats of certain phases of this problem not touched upon in the present paper.

An especial study of the antennal variation of this species is under way, it being purposed to tabulate at least 1000 antennæ, with camera lucida sketches of the more significant variations. The two extremes of the variable series show a difference wide enough to "separate *lanigera* from *americana* on good antennal characters." However, a large series renders a separation on this basis impossible. Although the discussion of this important point is postponed until the requisite data are tabulated, it may be of interest in this connection to state that a single collection of elm leaf migrants made at Orono show a range of from 19 to 32 annular sensoria on antennal joint III, 4 to 9 on IV, 2 to 10 on V, 0 to 2 on VI.

White Grubs (*Lachnosterna* species). These common pests were excessively abundant the past summer, at least in Albany, Columbia and Rensselaer counties, N. Y., they being so very numerous in many fields as to destroy practically all the grass roots so that large patches were badly pulled by the horse rake. Strawberry beds and corn were also seriously affected, especially when planted on sod. The greatest damage was confined to old seedings or meadows and usually to moister portions of the fields. These grubs were probably a little over a year old and may be those of *Lachnosterna fusca* Froh., since this was one of the species abundant in May and June 1911. In addition to these two, *L. grandis* Sm., *L. hirticula* Knoch and *L. hirsuta* Knoch were observed in abundance last year. Several species of June beetles were numerous last spring so that a continuance of the above noted depredations, probably on a more limited scale, may be expected in 1913.

E. P. Felt.

SCIARA SCIOPHILA LARVÆ CONGREGATING IN CHAINS

By J. S. Houser, *Department of Entomology, Ohio Agricultural Experiment Station, Wooster, Ohio*

About the middle of July of the present year there was reported to this department by Mr. C. R. Neillie, of the Cleveland City Department of Forestry, a serious outbreak of this insect, occurring on a lawn in Shaker Heights, Cleveland, Ohio. The writer was detailed to investigate the trouble and found that the insects had been present for two or three weeks. During this interval, on account of their repulsive appearance, they had been causing the inhabitants of the place a great deal of discomfort.

I was told by one member of the household as well as by the gardener, that the larvæ, especially in the early mornings, had exhibited a tendency common with some members of this family, to march in chains about the lawn, on the drives, along the foundation of the house and in similar places, but I was unfortunate in arriving just after the gardener had completed his customary morning rounds of pouring gasoline upon the insects and hence I did not see them in motion. The columns, however, were said to have varied in size from a half inch in width and two or three inches long, to those four inches in width and two or three feet long.

Something of the magnitude of the scourge may be gained from the fact that about a hundred gallons of gasoline had been used for killing the insects and that the putrid decaying masses of their bodies were to be seen in sheltered crannies everywhere, though in greater quantity along the walls of the house, at the bases of trees, along the sides of the walks, etc. On a number of places in the lawn, grass had been killed by the gasoline over areas of several square feet.

At the time of my visit the numbers of the larvæ were decreasing, but the flies were still abundant on the lawn and in the bordering woods. A collection was taken from both places, as was also one of larvæ and pupæ from the decaying mould of the woods. Within a short time adults emerged from the latter, and specimens of all three lots were sent to Dr. O. A. Johannsen, to whom I am indebted for the determination of the species. The insects developed not only in the woods, but in the lawn proper as well, for both larvæ and pupæ were found in the turf. As far as I was able to determine, the scourge was confined to the one lawn of about an acre and a half in extent.

"THE MINNESOTA FLY TRAP"

By F. L. Washburn, *Experiment Station, St. Anthony Park*

We have found the trap described herewith a valuable auxiliary in reducing the number of flies where these occur in large quantities.

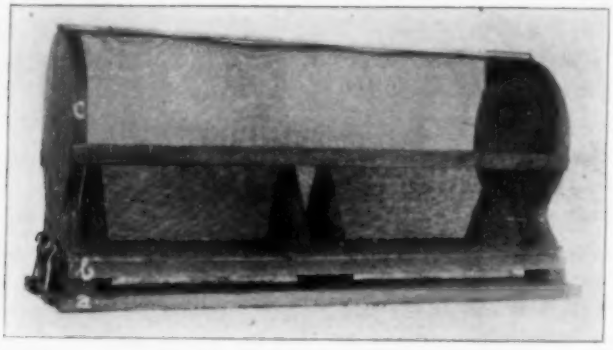


Fig. 7. General View of Trap

The trap is twenty-four inches long, twelve inches high and eight inches wide. It has been given a thorough test this summer with most satisfactory results. Whether the traps are rectangular or oval

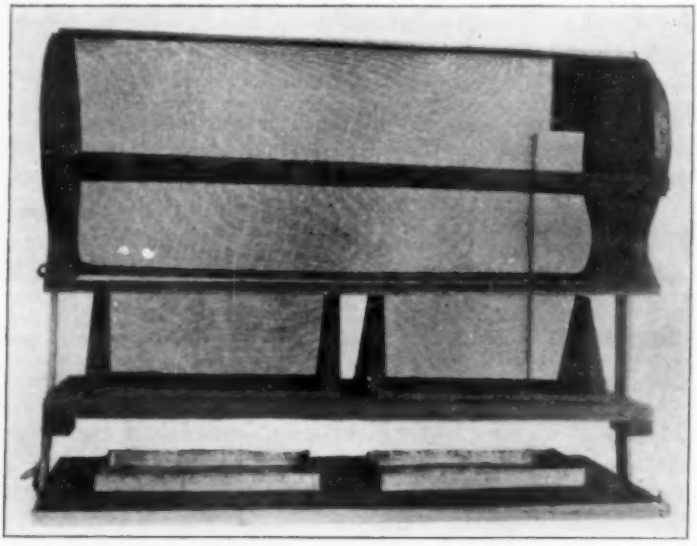


Fig. 8. The three parts of trap separated to show construction. The upright pieces at the ends are not a part of the trap.

seems to make no difference as regards their efficiency. The screen used is ordinary wire mosquito screen and that and the small amount of lumber required made each trap cost us 41c. for material. Made in large numbers the cost would be very much less. A skillful carpenter could easily construct this apparatus in two or three hours. The upper oval part (*c*) serves as a receptacle which the flies enter through the opening in the top of the middle portion (*b*) made of screen and shaped like the roof of a house. Under this is the base board (*a*), upon which rest two tin bait pans. The space between the baseboard and the middle portion is about one-half inch, and between this and the bait pans through which flies enter pans, about one-fourth of an inch.

The record made by one of these traps is in part as follows:

Rear of dining hall on campus, two days, 3000 flies
Dairy Barn, one day, 1700 flies.
Rear of dining hall, five days, 13,000 flies
Same place, three days, 6000 flies
Same place, one day, 4200 flies
On back porch of a dwelling not far from a stable where a few horses are kept, two days, 8700 flies
Same place, one day, 12,000 flies
Same place, one and a half days, 18,800 flies

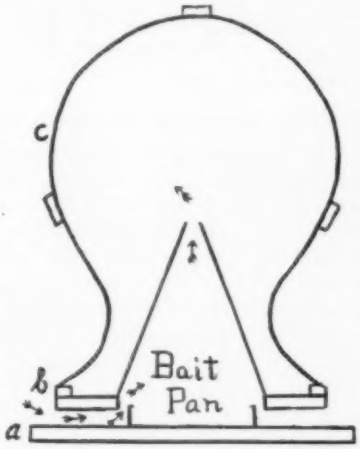


Fig. 9. Cross section of trap.

Bait: This is an extremely important factor in the use of this trap, and we find we have to qualify to a certain extent previous recommendations in this regard. Ordinarily, we believe that bread and milk, frequently renewed, is the best bait for this and other fly traps, but under certain conditions, this is not as attractive as it might be. For example: We loaned one of these traps to a dining hall association

on the State Fair grounds this month to be used in the kitchen. It was found that waste, stale meat thrown into a box was more attractive to the flies than bread and milk in the trap. This was overcome by putting small pieces of the stale meat in the pans with the bread and milk and the receptacle of the trap was soon swarming with thousands of flies.

The flies, which gather in the upper part or receptacle, should be killed by immersing that part of the trap in hot water or pouring boiling water over it, or in any other way not injurious to the trap. The dead flies may be emptied out of the trap, the bait renewed and the trap reset.

We have been so pleased with the success of this contrivance that we have proposed for it the name which is used at the head of this article.

ARTHROCNODAX OCCIDENTALIS N. SP. (DIPT.)

By E. P. Felt, *Albany, N. Y.*

The small, yellowish species described below and easily separated from other American forms by the emarginate ventral plate, was reared July 15 and 30, 1912, by H. J. Quayle of the Division of Entomology, University of California, Berkeley, from larvæ preying on red spiders, Tetranychus species.

Male. Length 1 mm. Antennae a little longer than the body, thickly haired, pale straw, yellowish basally; 14 segments, the fifth having the stems with a length 2 1-2 and 3 1-2 times their diameters. Palpi; the first segment short, irregular, the second with a length over twice its width, the third 1-2 longer than the second, the fourth a little longer than the third, slender. Mesonotum fuscous yellowish. Scutellum and postscutellum yellowish. Abdomen pale yellowish, with a reddish orange spot basally. Halteres yellowish transparent. Wings hyaline. Legs mostly pale straw, the distal tarsal segments somewhat darker; claws slender, evenly curved, the pulvilli as long as the claws. Genitalia fuscous yellowish, both dorsal and ventral plates triangularly emarginate, each with the lobes sparsely setose apically. Type a 2328.

THE EGG OF THE BLACKBERRY LEAF-MINER

Metellus rubi Forbes (*Scolioneura capitalis*)

C. R. CROSBY, *Ithaca, N. Y.*

Prof. C. O. Houghton has recently published an excellent account of the Blackberry Leaf-miner (Del. Agr. Exp. Sta. Bull. 87. 1910) but states that he has not observed the egg. The following note is presented to help fill this break in our knowledge of the life-history of the insect.

On August 25, 1908, the writer visited a large field of dewberries at Ripley, N. Y., which earlier in the season had been rather severely infested. The larvæ of the second brood were just beginning their mines. A careful examination of the under side of the leaves showed that the mines usually start near a prominent vein and that at their base a small round blister is present. These blisters are about .75 mm. in diameter, nearly round, low, green in color, and have a smooth surface. They are usually found close to a prominent vein and *two* are often placed close together. The egg itself is nearly white, smooth, flattened and lies between the two layers of the leaf. Plate 10, fig. 1 shows one of the blisters intact; the other has been opened and the egg partly removed. The blisters are rather inconspicuous but after one becomes used to looking for them can be easily detected without the aid of a lens.

According to the observations of Professor Houghton the eggs are probably inserted into the leaf from the upper side (Ent. News, XIX, p. 213. 1908)

Fall Army Worm (*Laphygma frugiperda* Sm. & Abb.). This insect was exceptionally abundant the latter part of September and early October in lawns and fields in the vicinity of New York city and on the eastern extremity of Long Island. There were several complaints of serious injury to lawns, the parties reporting the grass to be so seriously affected that they were fearful it would be destroyed. The caterpillars were reported very injurious to corn on Long Island. The larvæ, as is characteristic of this species, vary greatly in coloration. This outbreak is unusual for New York state or else, owing to the lateness of the season when the pest is usually abundant, is generally overlooked.

E. P. FELT.

APHID NOTES FROM CALIFORNIA

By W. M. Davidson,[1] *U. S. Bureau of Entomology, San José, Cal.*

The following paper reports several plant-lice not heretofore found in California, of which three species are new to science. A few sexual forms are also dealt with and illustrated.

Cerataphis lantaniae Boisd.

Taken in the spring of 1912 on ferns in the greenhouses of Stanford University, Cal., by Mr. H. Morrison.

Phyllaphis coweni Gillette.

Syn. *Cryptosiphum tahoense* Davidson (Jour. Econ. Ent. Dec. 1911).

I have not seen the types of *Phyllaphis coweni* but after comparing Gillette's description of this aphid (Can. Ent. xxxvii p. 125, 1905) with my description and specimens of *C. tahoense* I conclude that there is but one species.

Calaphis betulaecolens Fitch (Fig. 1, 2).

Alate male. Pale yellowish-green. Head, prothorax, thoracic lobes and two spots at the base of the wings black. Antennae reaching beyond cauda, yellow, apices of joints 3-6 and the filament dusky. Length of the joints as follows,—3, 4, 5, filament, 6, 1, 2. Legs yellow, femoral apices brown, base and apex of tibiae and the tarsi dusky. Wings large, stigma light gray with a large paler central area. Basal third of stigmatic vein obsolete. Second fork of third discoidal slightly nearer to the first fork than to apex of wing. Subcosta and discoidals stout, dark brown. Abdomen narrower than thorax, shorter than the head and thorax combined, greenish-yellow, with a dorso-median black transverse bar on all the segments except the last. Cornicles pale, almost as broad as long, situated on segment 7. Pale lateral tubercles occur on segments 2–6. Last segment dusky grey. Beak very short, reaching first coxæ, stout and pale, the tip black. Under side of the thorax grey. Sensoria as follows:—III, 18–24: IV, 0:V, 1:VI, 1.

Measurements:			Antennal joints	
Body, length	2.05mm		I	.110
" width	1.54mm		II	.078
Wing expanse	7.70mm		III	.906
Cornicles	.08mm		IV	.633
			V	.550
			VI	.216
			fil.	.462

Oviparous female. Pale yellowish-green, caudal half of abdomen with a reddish tinge. Antennae reaching to cornicles or beyond, black, joints 1, 2, basal half of both 3 and 4 paler. Eyes red, Legs pale, base of tibiae and tarsi black. Cornicles longer than broad, the mouth flaring. Dorsum of body sometimes with indefinite dusky markings. Abdomen oval, the last three segments forming a conical addition.

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[1]Published with the permission of the Chief of the Bureau of Entomology.

Measurements;	Body, length	3.13mm	Antennal joints I	.142
	" width	1.37mm	II	.076
	Cornicles	.16mm	III	.682
			IV	.491
			V	.417
			VI	.191
			fil.	.433

The sexual forms occur in November on cultivated Birch. Locality, Oakland, Cal.

Calaphis castaneae Buckton (Figs. 3, 4).

Alate male. General color lemon. Eyes dark red. Antennae reaching beyond the tip of the abdomen, dusky, joint 3 the longest and three times as long as the filament. Sensoria distributed as follows;—joint 3, 20; joint 4, 7; joint 5, 8; joint 6, 3–4. Thoracic lobes and scutellum brownish. Wings of medium size, stigmatic vein deeply curved, second fork of third discoidal slightly nearer to the wing apex than to the first fork. Stigma light brown, central portion lighter. Legs pale; tarsi, tibial apices and base of hind tibiae dusky. Abdomen narrower than the thorax, tapering gradually caudad, each segment with a median oval dusky area and dusky lateral spots. Cornicles dusky, almost twice as long as broad. Cauda globular, dusky, shorter than the cornicles. Beak pale, tip black, reaching midway between first and second coxae.

Measurements;	Body, length	1.33mm	Antennal joints I	.064
	" width	.50mm	II	.055
	Wing expanse	4.87mm	III	.621
	Cornicles	.06mm	IV	.413
			V	.285
			VI	.120
			fil.	.194

Oviparous female. General color pale lemon yellow. Eyes dark red. Antennae not quite reaching to cornicles, pale, with the articulations and filament dusky; joint 3 longest, twice as long as the filament or as joint 5. Body oval, tapering posteriorly to the cornicles, beset with many long delicate spines. Abdominal segments 1–8 each with two oval, transverse dusky areas on the dorsum. Cornicles pale, twice as long as broad. Cauda bluntly rounded, short. Legs pale, tarsi and tibial apices dusky.

Measurements;	Body, length	2.11mm	Antennal joints I	.071
	" width	.95mm	II	.050
	Cornicles	.12mm	III	.414
			IV	.247
			V	.190
			VI	.115
			fil.	.176

The sexual forms are found on Chestnut in early November. Locality, San José, Cal.

Euceraphis betulae Kalt. (Fig. 5.)

Oviparous female. Slightly woolly, body spindle-shaped, broadest at the third abdominal segment. Head and dorsum of the prothorax greyish-brown. Eyes red. Antennæ mostly dusky, reaching to the base of the cornicles, on small frontal tubercles, joint 3 the longest and in order after that 4, 5, 6, the filament, 1 and 2. Rest of thorax and abdomen greenish-yellow or yellowish-brown, meso- and metathorax and first five abdominal segments with lateral black spots and transverse rows of black or brown spots on the dorsum. Cornicles black, slightly longer than broad, their apices slightly enlarged. Cauda rounded, concolorous with the body, with a marginal fringe of hairs. Front of head bears four short hairs. Legs green with greyish tinge, tarsi and tibial apices black. Beak pale, reaching second coxae.

Measurements;	Body, length	3.50 mm	Antennal joints	I	.171
	" width	1.21 mm		II	.101
	Cornicles	.107mm		III	1.014
	Cauda	.087mm		IV	.700
				V	.585
				VI	.208
				fil.	.188

Male. Not taken.

The sexual female is abundant on cultivated Birch in November. Locality, Oakland, Cal.

Euceraphis flava sp. nov. (Figs. 6, 7).

Alate viviparous female. Pale yellow, covered with greyish-white woolly secretion. Antennae one-fifth longer than the body, mounted on frontal tubercles; joint 1 twice joint 2 in length and half as wide again; joint 3 much the longest, almost equaling 4 and 5 combined; joint 5 a little shorter than 4 and twice as long as 6; the filament four-sevenths as long as joint 6. First two joints encircled with a broken black ring at about half their lengths. Articulations of other joints black. Sensoria distributed as follows:—joint 3, 5–7, oval, transverse sensoria on its proximal fifth; joint 5, 1 apical sensorium; joint 6, 1 large apical sensorium and 3 smaller ones. Head and ocelli pale yellow. Eyes dark red. Prothorax pale with two parallel longitudinal dark stripes, one on either side of the dorso-median area. Thoracic lobes and scutellum pale brown, the latter with a black posterior border. Wings of medium size, stigma narrow, extended, pale grey; veins narrow, brown; sub-costa pale grey. Legs long, thin, pale yellow; tibiae dark brown at the base and apex; tarsi dark brown. Abdomen long and narrow, with three pairs of tubercles on its anterior half, one pair on each of the segments 2–4 inclusive. These tubercles are dark brown, wart-like, directed latero-caudad. Cornicles dark brown, as broad at the base as long, situated on a semicircular brownish area. Seventh segment with a pair of smaller dark lateral tubercles. Posterior margin of segment 8 with a brown cross-band. Cauda short, pale, globular. General color of the abdomen light yellow. Beak pale, tip brown, extending a little beyond the first coxae. Lower side of body pale yellow.

Measurements;	Body, length	3.33mm	Antennal joints	I	.128
	" width	1.18mm		II	.067
	Wing expanse	8.64mm		III	1.436
	Cornicles	.07mm		IV	.787
				V	.685
				VI	.358
				fil.	.206

Pupa of alate female. Pale yellow, with no woolly secretion. Antennal annulations and tarsi black. Rest of body pale yellow with the exception of abdominal black spots arranged as follows; two median dorsal and two lateral on segments 1–5 and 7, two median dorsal on segment 6 (on which occur the cornicles). These black spots are tuberculate and bear capitate hairs.

This species is not uncommon on the under side of the leaves of *Alnus rhombifolia* Nutt. I have never seen the apterous female nor the sexual forms. Habitat; Santa Clara Co., Cal. Spring and Summer.

Aphis cardui L.

Colonies on the young growth of several thistles throughout summer. Habitat; San José, Cal.

Aphis atriplicis L. (Figs. 8, 9).

Apterous male. Head, thoracic lobes and scutellum black. Prothorax brown. Eyes dark red. Anntenae black, reaching to the cornicles, third joint the longest, filament next, then fourth, fifth, sixth, first and second in order. Frontal tubercles small, black. Lateral tubercles absent. Legs brown, hind pair darker. Abdomen pale yellow, with 8 brown dorsal transverse bars, which are often broken up into spots. Cornicles short, black, incrassate, not half as long as the hind tarsi. Cauda black, tapering to a blunt apex, half as long again as the cornicles. Genital segment below cauda large, black, rounded. Coxae, under side of head and thorax and genital segment black. Rest of lower surface yellow. Beak transparent, its tip black, reaching second coxae. Sensoria on antennal III 18–21; IV 7–9; V 6–8; VI 3–5, small, placed irregularly on the much serrated antennae.

Measurements;	Body, length	1.08mm	Antennal joints	I	.057
	" width	.46mm		II	.050
	Cornicles	.078mm		III	.300
	Cauda	.086mm		IV	.151
				V	.185
				VI	.121
				fil.	.257

Oviparous female. Entirely pale greenish-yellow, with a thin white powdery covering. Eyes red. Antennae seven-jointed, about one-third the length of the body, pale greenish-yellow; the relative size of the joints as follows: joint III longest; the filament or seventh joint a little shorter with IV; V and VI sub-equal. Legs pale greenish-yellow, coxae brown. Cornicles pale brown, almost as long as the hind tarsi. Cauda shaped as in the male, pale brown, slightly exceeding the cornicles in length. Anal segment brown. Beak not quite reaching second coxae, its tip brown.

Measurements;	Body, length	1.57mm	Antennal joints	I	.064
	" width	.77mm		II	.043
	Cornicles	1.07mm		III	.179
	Cauda	1.30mm		IV	.086
				V	.093
				VI	.088
				fil.	.133

Apterous viviparous female. Pale green, slightly pulverulent. Body more than twice as long as wide. Antennae dusky, a little over one-third the body in length;

joint III the longest, filament next, then joint IV and V sub-equal, then VI, I and II. Legs entirely dusky brown. Cornicles green, slightly incrassate, small, barely exceeding the fore tarsi in length. Cauda slightly dusky, a little longer than the cornicles, widest at the base, tapering gently to a blunt apex. Eyes dark red. Beak dusky, very short, reaching midway between first and second coxae. Coxae very dark.

Measurements;					
Body, length	1.82mm	Antennal joints	I	.083
" width	.83mm		II	.057
Cornicles	.147mm		III	.302
Cauda	.226mm		IV	.131
			V	.127
			VI	.103
			fil.	.217

Occurs on the upper side of the leaves of *Chenopodium murale* L., the sexual forms appearing in August. Habitat; San José, Cal.

Aphis salicicola Thos.

Abundant on Willows throughout the summer. Preyed on by the larva of a *Leucopis* (Agromyzidae). Habitat; San José, Cal.

Aphis maidis Fitch.

Colonizing Corn (*Zea mays*). Habitat; San José, Cal.

Amphorophora latysiphon sp. nov. (Figs. 10–13.)

Alate viviparous female. General color dark olive green. Head, prothorax, thoracic lobes, scutellum, frontal tubercles, first two joints of the antennae, cornicles and cauda black. Legs yellowish-brown; distal half of the femora, distal third of the tibiae and the tarsi darker. Eyes dark crimson lake. Antennae on frontal tubercles, which bear hairs on their inner angles, half as long again as the body, armed with many hairs; third joint the longest, joints 4 and the filament sub-equal, joints 6 and 1 sub-equal, joint 5 a little shorter than joint 4. Sensoria distributed as follows;—joint 3, 13–17 on the exterior margin in an irregular row; joint 5, 1 apical; joint 6, 1 large and 3 small, all apical. General color of antennae yellowish-brown. Lateral tubercles small, bearing a hair. Wings of medium size, veins brown, stigma amber-colored, second fork of third discoidal close to the wing apex. Abdomen oval, yellowish-green or dark olive, with a large sub-quadrate black spot on the dorsum above the cornicles and a black cross-band on the segment below the cornicles and black lateral spots. Cornicles long, very much dilated for half their length. Cauda ensiform, about one-third the length of the cornicles. Under side of the body and beak olive green; tip of beak and sterna black. Beak reaches second coxae. Coxae dusky.

Measurements:					
Body, length	2.54mm	Antennal joints	I	.149
" width	1.17mm		II	.088
Wing expanse	8.75mm		III	.977
Cornicles	.67mm x .157mm		IV	.771
Cauda	.19mm		V	.554
			VI	.163
			fil.	.733

Apterous viviparous female. General color of the body light olive green. Eyes dark red. Antennal articulations, prothorax, cauda, and a large quadrate spot on the dorsum of the abdomen dusky to black. Cornicles black. Antennae on large

frontal tubercles, longer than the body with the relative size of the joints as in the winged form. Legs light olive, apical half of femora, tibial apices and tarsi dusky to black. Cornicles and cauda shaped as in the winged form. Beak pale, tip black, reaching to second coxae.

Measurements;– Body, length	2.57mm	Antennal joints I	.190
" width	1.44mm	II	.097
Cornicles	.73mm x .10mm	III	.887
Cauda	.18mm	IV	.681
		V	.504
		VI	.151
		fil.	.700

Occurs sparingly on the Periwinkle (*Vinca major*) and *Convolvulus arvensis*. Habitat; San José and Courtland, Cal.

Phorodon carduinum Walker.

On the under side of the leaves of Artichoke, becoming a pest. Very susceptible in California to fungus diseases. Kindly determined by Mr. J. T. Monell. Habitat; San José, Oakland and Courtland, Cal.

Myzus varians sp. nov. (Figs. 14–19.)

Pupa of alate female (viviparous), dark form. Pale yellow, prothorax, anterior half of the abdomen, 7th abdominal segment purplish-red. Head pale yellow; ocelli prominent, light red. Eyes dark red. Antennae on large frontal tubercles, reaching to the base of the cornicles, pale yellow; articulations of joints 3–6 and the filament black. Filament the longest joint, then 3, 5, 4, 6, 1, 2 in this order. Legs pale yellow, tarsi black. Sutures of thoracic lobes reddish, wing pads pale with dusky tips. Abdomen broadest at the fourth segment, then tapering abruptly to the cauda. Cornicles about as long as antennal joints 4 and 5 together, narrowing from the base and curved, pale with the tip black. Cauda almost colorless, conical, as long as the hind tarsi. Beak pale, tip black, reaching the second coxae. Under side of the abdomen and thorax more or less reddish.

Measurements;–Body, length	1.73mm
" width	.72mm

Alate viviparous female, dark form. Pale greenish-blue, first three and last two abdominal segments tinged with crimson (fainter in some individuals). Rest of abdomen with a faint bluish tinge. Head and antennae black. Eyes dark red. Frontal tubercles prominent. Antennae exceeding the tip of the abdomen, base of third joint pale; relative sizes of the joints as in the pupa. Prothorax brownish-red. Thoracic lobes and scutellum deep brown. Wings large ; sub-costa and insertions reddish-grey; stigma long, narrow, grey; veins narrow, grey, second fork of the cubitus or third discodial slightly nearer to first fork than to the wing apex. Legs yellowish-red, apical half of femora, tarsi, and tibial apices black. Abdomen widest at segment three, with dusky transverse bands which sometimes coalesce to form a quadrilateral area on the dorsum, and with black lateral spots, and with a transverse dusky bar below the cornicles. Cornicles dusky, slightly curved, rather narrowed at the apex, not quite as long as antennal joint 3 and not quite reaching the tip of the cauda. Cauda black, conical, upturned, equalling the hind tarsi in length.

Under side of thorax black, of abdomen reddish. Beak pale, reaching midway between first and second coxae. Sensoria distributed as follows;—joint 3, 9–12 circular, in an irregular row; joint 5, 1 terminal; joint 6, 1 large and 3 small, terminal.

Measurements;—			Antennal joints	
	Body, length,	2.28 mm	I	.106
	" width	1.05 mm	II	.078
	Wing expanse	7.16 mm	III	.550
	Cornicles	.407 mm	IV	.334
			V	.365
			VI	.132
			fil.	.682

Alate viviparous female (Light form). Pea green. Antennae on prominent frontal tubercles, longer than the body, black with joints 1 and 2 green and joints 4 and 5 light brown. Eyes dark red. Head and prothorax light brown, rest of the body green. Abdomen wider than the thorax, widest at the fourth segment. Wings large; stigma greyish-yellow, narrow and long; insertions and sub-costa greenish-yellow; second fork of third discoidal about midway between first fork and the wing apex. Legs green, knees, tarsi and tibial apices black; tibiae yellowish. Cornicles green, slightly curved, six times the hind tarsi in length, shaped as in the dark form. Cauda short, dusky, conical. Beak green, tip brown, not quite reaching second coxae. In the single specimen that I have there are 9 sensoria on joint 3 of the left antenna and 10 on joint 3 of the right antenna. Joint 5 has 1 terminal sensorium and joint 6, 4 terminal sensoria. The antennae of this form differ from those of the dark form by having joint 4 longer than 5.

Measurements;–			Antennal joints	
	Body, length	2.30mm	I	.114
	" width	1.04mm	II	.080
	Wing expanse	7.13mm	III	.671
	Cornicles	.57mm	IV	.562
			V	.521
			VI	.153
			fil.	1.031

Apterous viviparous female. General color pea green. Filament and articulations of the antennal joints black. Mouth of the cornicles black. Eyes red. Tarsi grey. Antennae on very conspicuous toothed frontal tubercles, reaching to the base of the cornicles. Relative lengths of the antennal joints as in the green winged form. Legs slender, green; all tarsi grey. Cornicles green, curved, with tip black, five or six times the hind tarsi in length. Cauda green, conical, half as long again as the hind tarsi. Beak green, with a brown tip and extending to the second coxae.

Measurements;–			Antennal joints	
	Body, length	1.96mm	I	.124
	" width	1.51mm	II	.052
	Cornicles	.44mm	III	.383
			IV	.350
			V	.297
			VI	.132
			fil.	.604

Occurs on the under side of the leaves of wild Clematis (*Clematis ligusticifolia* Nutt.). The alate green forms are very rare while the

dark forms apparently do not appear until November. No sexual forms were collected. Habitat; San José, Cal.

Amphorophora rubi Kalt.

Colonizes the terminal shoots of cultivated blackberry and loganberry and is also to be found on the wild thimble-berry (*Rubus nutkanus* Moc.). I am indebted to Mr. J. T. Monell for the determination of this species. Habitat; San José, Cal.

Macrosiphum chrysanthemi Oestl.

On the young shoots of a composite. Habitat; Courtland, Cal.

Macrosiphum granarium Kalt.

Occurs on various grasses in spring. Habitat; San José, Cal.

Macrosiphum solanifolii Ashm.

Occurs on wild lettuce. Habitat; San José, Cal. I am indebted to Miss E. Patch for the identification of this species.

Explanation of Plates 11, 12: 1, *Calaphis betulaecolens*, alate male; 2, *C. betulaecolens*, oviparous female; 3, *Calaphis castaneae*, alate male; 4, *C. castaneae*, oviparous female; 5, *Euceraphis betulae*, oviparous female; 6, *Euceraphis flava*, alate viviparous female; head and antenna; 7, *E. flava*, abdomen; 8, *Aphis atriplicis*, alate male; 9, antenna of same enlarged; 10, *Amphorophora latysiphon*, head; 11, antenna; 12, cornicle; 13, cauda; 14, *Myzus varians*, head of alate viviparous female, dark form; 15, antenna of same; 16, cornicle of same; 17, head of apterous viviparous female; 18, antenna of same; 19, cornicle of same. I am indebted for these figures to Miss E. Weber, formerly in the employ of the Bureau of Entomology.

Locust Leaf Miner (*Chalepus dorsalis* Thunb.). This common enemy of the black locust was excessively abundant on Long Island in 1911, the beetles, in association with the rosy hispa, *C. nervosa* Panz., skeletonizing the foliage of young locust trees over extended areas in the vicinity of Syosset. A recurrence of the attack was observed in August 1912, the injury being confined as previously, largely to the smaller trees and, the past season, being due almost entirely to work by *C. dorsalis*. The mines made by the grubs were of comparatively little importance where the feeding of the adults in August resulted in skeletonizing the foliage over large areas, the beetles being so numerous that 2, 4, 6 and even 8 were found on individual leaflets. It is evident that a thorough spraying, the latter part of July or early in August, with arsenate of lead would effectually control outbreaks of this character.

E. P. Felt.

Plate 11

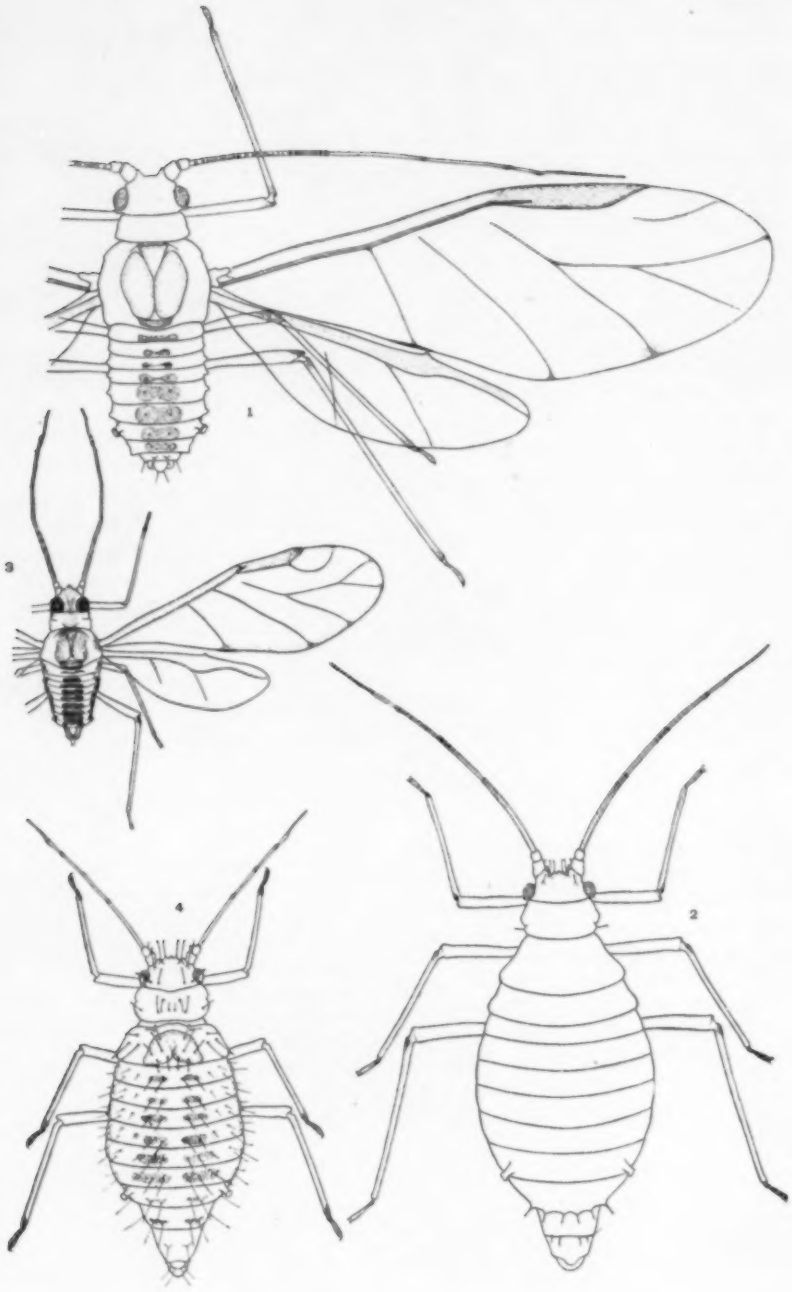
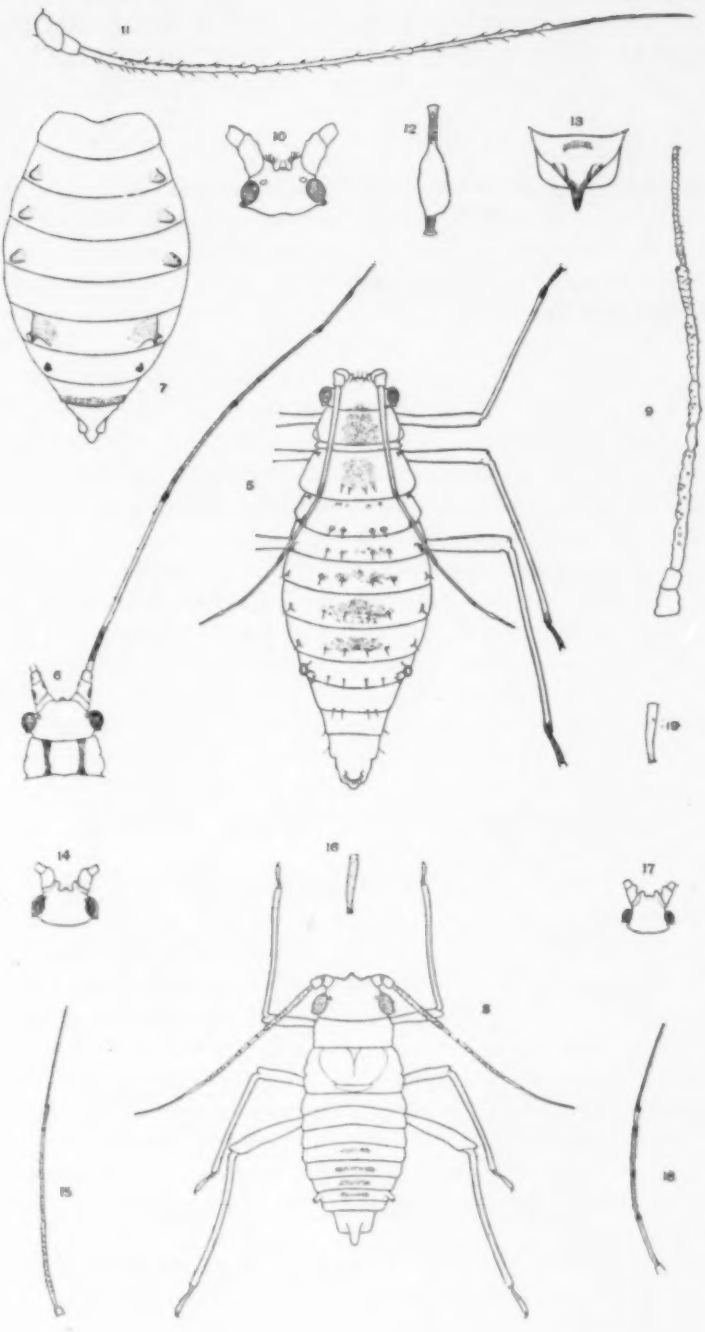


Plate 12



THE OCCURRENCE OF THE CITRUS RED SPIDER, TETRANYCHUS MYTILASPIDIS RILEY, ON STONE AND POMACEOUS FRUIT TREES IN OREGON

By H. E. Ewing, *Agricultural Experiment Station, Corvallis, Ore.*

In November of last year, while examining some leaves and twigs of apple trees at Corvallis for the common red spider of our eastern states and of Europe, *Tetranychus telarius* L., I came across another species which could easily be distinguished from *T. telarius* L. by the use of my hand lens. Upon examining specimens with the compound microscope in the laboratory, I was much surprised to find that this species was no other than *Tetranychus mytilaspidis* Riley, the well-known red spider of citrus trees in southern California. Since this initial observation several records have been made of this species in Oregon. The writer submits the following notes on its biology and economy under the influences of its new host plants and new climatic conditions.

In the autumn when the leaves of the deciduous fruit trees begin to brown, die, and fall, these mites change their summer habit of depositing eggs upon the leaves of the trees, and deposit nearly all of them on the twigs. After egg deposition the adults fall to the ground with the leaves and die. These eggs are always deposited singly, and may be placed very close together so that at times scores or even hundreds will be found almost touching one another. They are laid preferably at the bases of the last year's shoots or around the bases of the fruit spurs. Here they frequently become so numerous as to make these portions of the twig look quite red.

The eggs remain on the twigs over winter, and in Oregon suffer little from the hardships of moisture or low temperature, and are, at present, remarkably free from the attacks of predaceous enemies. During the month of April the eggs hatch, and the newly emerged, six-legged larvæ run about hunting for the opening leaf buds or the first tender leaf shoots where at once they begin to feed. By the seventh of May, at Corvallis, I found all instars present, as I did from this time on until the end of the season. These mites continue to feed and reproduce from the time of hatching in April until the end of the rainy season but with very little vitality. So few individuals are present at this time of the year that they are completely overlooked by fruit growers.

It is during July that the decrease in the humidity and the great increase in temperature causes these mites to reproduce and feed with great vigor. Now the adults become very active, and eggs are found

scattered about all over the leaves. It is during this season that the species becomes very injurious to the trees by sapping the juices from the leaves and causing the latter to become pale or spotted and to curl up around the edges.

This species doubtless can be held in check by the use of summer sprays similar to those recommended for it in California; but, since the winter is passed only in the egg instar and these eggs are deposited in an exposed position, doubtless some dormant spray will be found that will be more satisfactory. I may add that lime-sulphur is not a satisfactory winter spray for the eggs of this mite. It will not kill the embryos in the eggs at all, but will, however, kill some, and at times perhaps 60 percent or 70 percent, of the larvæ after they have emerged.

The following records of the species in Oregon have been made and are here presented in tabular form:

RED SPIDER IN OREGON

Locality	Date	Host plant	Instars present	Situation and injury
Corvallis	Nov. 16	Apple	Chiefly adults and eggs	Adults on fallen leaves. Eggs on twigs
Salem	Dec. 19	Prune	Eggs	On twigs
Corvallis	Dec. 26	Apple	Eggs	On fallen leaves
Linn County	Feb. 11	Peach and prune	Eggs	At the bases of the last season's growth of twig
Eugene	Feb. 16	Apple	Eggs	On bases of twigs and spurs
Corvallis	Feb. 24	Apple	Eggs	At bases of spurs and on rough places on twigs
Corvallis	March 19	Prune	Eggs	On twigs. Thickest at bases of spurs
Salem	March 20	Prune	Eggs	Slight infestation on twigs
Salem	March 30	Apple	Eggs	Bad infestation of twigs
Estacada	March 30	Apple	Eggs	On rough bark of twigs and at bases of spurs
Corvallis	May 7	Apple	All instars	On the under side of young leaves
Corvallis	May 18	Apple	Adults and eggs	On leaves causing little injury
Corvallis	July 20	Apple	Adults and eggs chiefly	Causing slight injury to leaves
Corvallis	July 23	Prune	All instars	Very few individuals present; on some leaves; eggs numerous
McMinnville	July 25	Apple	All instars	No noticeable injury to leaves
Corvallis	Aug. 1	Apple	All instars	Injury slight
Corvallis	Aug. 17	Apple	All instars	Injury serious. Paling of leaves; also an upward cupping of edges of leaves

THE LIFE HISTORY AND HABITS OF CHEYLETUS SEMINIVORUS PACKARD

By H. E. Ewing, *Agricultural Experiment Station, Corvallis, Oregon*

Frequently found associated with some of our insect and mite pests is a little predaceous acarid, pale in appearance and less than a millimeter in length. This species was first described by Professor A. S. Packard in 1869. Since then it frequently has been observed by entomologists, usually in stored grain or grain products. The scientific name of this mite is *Cheyletus seminivorus* Packard. The specific name, *seminivorus*, means seed devouring; and doubtless was given to the species because it was believed that the acarid lived upon seeds. At any rate, it was first found in stored cabbage seed. The species, however, is not an enemy to seeds of any kind or to stored grains, for it is entirely carnivorous. When it is found among seeds or in stored grain it should be protected in every way, for it is there only to prey upon some other species, which is the real pest, whose destruction is to be desired.

During the last winter the writer came into possession of a sample of milled wheat which was infested with millions of Tyroglyphid mites. Associated with these Tyroglyphids were found at first only a few individuals of *Cheyletus seminivorus* Pack. Some of these were selected to be used in a series of experiments upon the life history and habits of this species. The following results were obtained.

Life History

Number of Eggs Laid and Rate of Deposition. Of the three females which I succeeded in getting to deposit eggs, one laid a total of 25 in a period of 6 days; another 22 in a period of 2 days; while the third laid only a single egg. The greatest number of eggs laid in one day by a single female was 11. The average rate of deposition per day for a single female was 5 1-3. All the females lived for several days after egg deposition had ceased. The eggs were laid near each other, but not in clusters; and the female remained by them for some time after deposition had ceased.

Length of Incubation Period. Of the 48 eggs laid in captivity 32 hatched. The minimum incubation period found for any one egg was 3 days, the maximum was 7 days. The average period of incubation for the 32 eggs was 4.31 days. These eggs were kept in cells at the ordinary laboratory temperature.

Description of Egg Instar. The egg is white, shiny, oblong-oval. It is about two thirds as broad as long. Generally the eggs are more convex on one side than on the other. During development the buds for the appendages may be seen through the egg-shell. Just before emergence the completely formed larva may easily be seen through the egg's shell. The egg-shell is a thin resistant membrane, which shrivels up after the hatching process. Measurements were made of 7 eggs which gave averages as follows: length, 0.130 mm.; breadth, 0.094 mm.

Percentage of Larvae Hatching from Eggs Deposited in Captivity. Of the eggs deposited in captivity 66 per cent. hatched. Those that did not hatch did not show developing embryos at any time, but soon began to shrivel and later to contract and dry up. I judged from this that they had not been fertilized.

Length of Larval Stadium. Of the 32 larvae which hatched from the eggs deposited I was able to get only 9 to live for any length of time. Yet out of these, 3 passed the larval instar into that of the first nymph. The minimum length of the larval stadium was 6 days, the maximum 9 days, the average 7.66 days.

Description of Larval Instar. Hyaline; in general appearance somewhat like the adult. None of the parts strongly chitinized. Beak very little chitinized. Palpal claw similar to that of the adult, but without the two tooth-like tubercles at its base. Inner serrula of palpal papilla about four-fifths as long as the outer and without teeth, being simply a large, curved bristle; outer serrula much stouter than inner, number of teeth 6 or 7. Antepenultimate segment as broad as long; femur of palpus but little swollen. Abdomen scarcely as large as cephalothorax. Three pairs of legs present. Measurements were made of three individuals which gave the following averages: length, 0.192mm.; breadth, 0.096mm.

The larva may at once be distinguished from the nymphs and adult by having only three pairs of legs instead of four as is found in the latter stages.

Length of First Nymphal Stadium. Two of the three nymphs passed this stadium successfully and became second nymphs. The length of the first nymphal stadium was in one instance 4 days, in the other 5 days. The other first nymph was killed in order to make a permanent mounted specimen of this instar.

Description of First Nymphal Instar. In general appearances this nymph is similar to the adult, but lacks certain structures while other structures which are found in the adult, in the first nymph have different proportions. Body and appendages, except the beak fleshy, soft, hyaline; tip of beak somewhat chitinized. Beak apparently shorter in proportion to the body than in the adult. Palpal claw as in the adult except the two tubercles at its inner side at the base are wanting. Outer serrula of palpal papilla with only 6 or 7 teeth; inner serrula without teeth, being simply a large, stout, curved, tactile seta; curved tactile seta of papilla as in adult. Antepenultimate segment and femur of palpus as in adult. Anterior pair of legs, relatively, much shorter in the first nymph than in the adult; tactile bristles of tarsus as long as the segment itself. Last pair of legs extending beyond the tip of the abdomen by one half their length. Total length of body, including the beak, 0.32mm.; width, 0.16mm.

Length of Second Nymphal Stadium. Of the two second nymphs obtained, one transformed in five days into the adult; the other, strange to say, lived in its cell for 32 days without transformation. At the end of this time it accidentally escaped. During this period it frequently became quiescent but at no time did it undergo transformation.

Description of Second Nymphal Instar. Very similar to the adult; beak and palpi showing more chitinization than in the first nymph. Beak and palpi very similar to that of the adult. Palpi stout, extending beyond the tip of the beak by about two fifths their length. Outer serrula of palpal papilla relatively larger compared to the palpal claw than it is in the adult, with 12 teeth; inner serrula with teeth, wherein it differs from that of the first nymph; number of teeth less than that of the adult, being only 9 or 10; curved tactile seta as in adult. Anterior pair of legs shorter than the body exclusive of the beak; tarsus considerably longer than the tibia as is true of the adult. Second pair of legs two thirds as long as the first pair; fourth pair of legs extending beyond the tip of the abdomen by one half their length. Total length of the body, including the beak, 48mm.; width, 0.26mm.

Length of Adult Stadium. The single adult obtained lived for 13 days and then died a natural death. This period corresponds very well with the length of time some of the adults lived which were not reared from eggs deposited in captivity.

Description of Adult. A very light yellow, almost flesh color; palpi and beak darker than the body and legs. Beak as long as the rest of the cephalothorax, more strongly chitinized at its tip than at its base and bearing not far from its tip a single pair of hairs or setae which extend one half their length beyond the beak. Palpi very stout, extending beyond the tip of the beak by two fifths their length. Last segment of palpus ending in a stout, curved, simple claw which extends beyond the tip of the outer serrula of palpal papilla by about one fourth its length. Two spurs or tubercles of about equal size are situated on the inner margin of the segment at the base of the palpal claw. Palpal papilla, or thumb, short, stout, as broad as long and bearing two serrulae and a large, curved, tactile seta; outer serrula much larger than the inner and almost as long as the palpal claw, with from 12 to 15 teeth, which increase in length as you pass from the base to the tip; inner serrula slightly over one half as long as the outer, with from 14 to 16 teeth, which are longest from the middle of the organ and become shorter as you pass toward the tip or base; curved tactile seta longer than the outer serrula and situated between and slightly below the two serrulae. Antepenultimate segment almost as broad as long; with but two setae which, however, are prominent; one is a large, curved, tactile seta situated on the inner margin of the segment next to the papilla, it is longer than the palpal claw; the other seta is situated on the ventral side of the segment. Femur of palpus one and a half times as long as broad; inner margin concave, outer margin convex. On the upper surface of the femur of the palpus is situated, a very long, simple or slightly pectinated bristle which is slightly longer than the segment itself. No other bristles on the upper surface of this segment. Cephalothorax broader than long excluding the beak. Eyes absent. Anterior pair of legs slightly longer than the body excluding the beak; tactile hairs on the tarsus sub-equal, and slightly shorter than the tarsus itself; tarsus longer than the tibia. Posterior pair of legs extending for almost one half their length

beyond the tip of the abdomen. Total length of body excluding the beak, 0.58 mm.; width, .025mm.

Habits

The Molting Process. I was unable to observe the actual process of molting, but an examination of the cast skins showed that they had been split transversely at or near the scapular groove. This rupture was sometimes complete, and the two parts of the old skin when cast remained separated from each other some distance. The process evidently is the same for all stages. In some instances the posterior part of the cast skin showed a lateral rupture passing backward from the transverse one.

Nature of Food. This species is entirely carnivorous in its diet, and much prefers to catch its prey. Young individuals prefer to live upon the eggs of other mites if they can obtain them, and individuals of all stages will suck the juices of freshly killed creatures if they are unable to catch live ones.

Method of Approach and Attack upon Prey. These predaceous mites are extremely cautious about attacking creatures even smaller than themselves. I have watched the process several times upon the stage of the microscope. An individual will first approach its suspected prey slowly and touch it with the long tactile hairs on its front legs. Then it will retreat. Again it will repeat the process from another direction and again retreat. Now the hind legs will be presented to the victim and again a retreat will be made. When several of these actions have been performed and apparently if the Cheyletus has decided that it has prey and not a dangerous enemy, it rushes upon the latter and seizes it at the nearest point of attack by means of its powerful palpi, inserts the beak, and begins to suck the juices.

The Feeding Process. The victims do not stop movement when seized by this mite, as is claimed to be true by some writers for species of Cheyletus; in fact, frequently they are not killed at all. If the Cheyletus has been fasting it will seize its victim and suck it dry. I observed one under such conditions, and it took just 13 minutes for the feeding process.

After the beak is inserted one can see the strong pharyngeal muscles contract and relax very rapidly, while the stomach and abdomen gradually become distended with the blood sucked from the victim.

Number of Victims Killed. The adult individuals of *Cheyletus seminivorus* will frequently attack and kill many of their victims and suck but little of the blood. When they are very hungry they suck their victims dry, but if plenty of food is at hand they do not suck them

dry. A single female in captivity killed 17 out of 20 Tyroglyphid mites in a day. Hence it will be seen that even in the adult stage alone, a great number of victims will be killed under favorable conditions, perhaps scores or even hundreds, by a single Cheyletid.

The Value of the Predaceous Habit as a Check upon the Ravages of Certain Pernicious Mites

Several entomologists have noticed the value of this species and others of the same genus in holding in check mite enemies of stored grain. Just how effective it is may be learned from the following: When the writer received the sample of milled wheat infested with millions of cheese mites (*Tyroglyphus* sp.) a careful examination of the same revealed but a few individuals of *Cheyletus seminivorus* Pack. Among the myriads of Tyroglyphids which swarmed in the ground grain scarcely any dead ones could be found. A short time after then I examined the same sample and found that out of 100 Tyroglyphids counted, 95 were dead and shriveled, 1 was dead but not shriveled, and only 4 were alive and active. Now the Cheyletids were common and everywhere busy seizing the Tyroglyphids and sucking their juices. Thus in a short period of only a few days this predaceous species had multiplied and destroyed about 95 per cent of the pernicious Tyroglyphids.

FEDERAL QUARANTINE NOTICES

Mediterranean Fruit Fly (*Ceratitis capitata* Wied.) Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine against the following fruits grown or shipped from the territory of Hawaii: Alligator pears, Carambolas, Chinese ink berry, Chinese orange, Chinese plums, Coffee berries, Damson plum, Eugenias, Figs, Grapes, Grapefruit, Green peppers, Guavas, Kamani seeds, Kumquats, Limes, Loquats, Mangos, Mock orange, Mountain apple, Natal or Kaffir plum, Oranges, Papaya, Peaches, Persimmons, Prickly pears, Rose apple, Star apple, String beans, and Tomatoes.

Potato Wart (*Chrysophlytis endobiotica* Schib.) Quarantine has likewise been declared against potato wart, potato canker, black scab etc. and the importation of potatoes forbidden from the following countries: Newfoundland, the islands of St. Pierre and Miquelon; Great Britain, including England, Scotland, Wales and Ireland; Germany; and Austria-Hungary.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

The recent enactment of a National Plant Quarantine Act is a great stride in applied or economic entomology and one which should have been taken years ago. The Federal Government is now charged with functions which could not be exercised by the various States and all may look for a much greater protection from injurious insects. Co-operation between National and State agencies should result in a maximum efficiency at a minimum expenditure. Some were afraid such a law might prove a serious hindrance to certain phases of the nursery business. There is no denying that the welfare of all should take precedence over the prosperity of a few. Nevertheless, the administration of this law will doubtless go far to prove the groundless character of these fears and show how the enactment can be interpreted in such a catholic spirit as to command the respect of all.

The campaign against the house or typhoid fly has been in progress for about a decade. The press has displayed a commendable interest, many dailies and weeklies publishing brief timely warnings or directions for controlling the fly. We have at least two volumes on this insect, a moving picture film, some local anti-fly ordinances, accompanied here and there by vigorous campaigns—and flies. This is no implication that conditions have not bettered in some localities. It is simply an invitation to pause and see what has been accomplished. The educational campaign has been a necessary prelude to activity and here and there, but only locally, have we seen an approach to a systematic attempt to control this familiar pest. Is it not time that the more progressive sentiment of many communities, not excluding States, was crystallized into ordinances and laws along the lines such as those suggested by the Indiana State Board of Health for city and villages? Most intelligent people accept in a placid manner, the statements respecting the dangerous character of the fly, but in comparatively few instances does this result in action. Furthermore, it is difficult to secure desirable activity so long as neighbors do not or can not be compelled to assist in an undertaking which must depend in large measure for success upon general adoption. Here is where

ordinances and laws are useful. Entomologists and others interested in bettering sanitary conditions might well turn their attention to this phase of the problem, since even the possibility of coercion proves a powerful stimulant to many who would otherwise be indifferent.

Reviews

Elementary Entomology, by E. DWIGHT SANDERSON and C. F. JACKSON, pages 372, figures 496. 1912.

The volume under consideration may be characterized as an excellent, profusely illustrated elementary entomology, admirably adapted to the needs of those interested or likely to become interested in the elementary or economic phases of the Science.

With less than 400 pages and nearly 500 text illustrations, the need of condensation is evident. Some 35 pages are devoted to a discussion of the external and internal anatomy, 22 pages illustrate growth and transformations, while over half the volume, about 200 pages, outline briefly the salient characteristics of the more important groups and incidentally notice many injurious forms. Scattered throughout the work there is much biological information, the value of the latter being greatly enhanced by the numerous figures of early stages in connection with those of the adult insect.

The laboratory work provides for the anatomical study and comparison of several typical forms and for biological work with aphids, the cabbage butterfly and the fruit fly. The keys to the orders and the more important families make it possible for students using this volume to become well acquainted with the entire group.

The authors have been successful in producing an admirable volume, small in size and moderate in price, which will appeal strongly to all having charge of elementary students in entomology. The paper is excellent, the printing clear, the figures distinct and the general appearance of the work most attractive.

The Wheat-Head Army-Worm as a Timothy Pest, by R. L. WEBSTER, Iowa Agricultural Experiment Station, Bulletin 122, pages 323–348. 1911.

The author gives an excellent comprehensive account of a timothy pest, *Meliana albilinea*. The discussion of control measures immediately following the characterization of the injury is a commendable feature in popular bulletins. The author advises clean culture, fall plowing and early fall pasturing. There is an excellent bibliography, a full life history and concise descriptions of the various larval stages. The excellent paper brings out the illustrations in a very satisfactory manner.

White pine blister rust (*Peridermium strobi* Kleb.) Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine against the following pines and their horticultural varieties, viz.: White pine (*Pinus strobus*), western white pine (*Pinus monticola*), sugar pine (*Pinus lambertiana*) and the stone or cembrian pine (*Pinus cembra*) originating in the following countries: Great Britain, France, Belgium, Holland, Denmark, Norway, Sweden, Russia, Germany, Austria, Switzerland and Italy.

Current Notes

Conducted by the Associate Editor

Professor S. W. Williston will make a paleontological expedition to South Africa this fall.

Mr. C. S. Brimley of Raleigh, N. C., has been elected president of the North Carolina Academy of Science.

Dr. J. S. Ward has been appointed inspector of Apiaries for the State of Tennessee, with headquarters at Nashville.

Mr. W. J. Price is now acting State Entomologist of Virginia, in place of Dr. E. A. Back who has resigned, to take up work in the Bureau of Entomology.

Mr. B. H. Walden, Assistant in Entomology at the Connecticut Agricultural Experiment Station, spent his vacation in Western Ontario, Can.

According to the report of G. M. Bentley, State Entomologist of Tennessee, there are 365 nurseries in Tennessee, with an annual income of $3,000,000.

Chas. T. Greene, Philadelphia, Pa., is now assistant in the Division of Forest Insect Investigations of the Bureau of Entomology. His specialty is Diptera.

Professor John Craig, professor of Horticulture in Cornell University and Editor of the National Nurserymen, died August 12th, at Siasconsett, Mass., aged 48 years.

According to *Science* a valuable collection of British Lepidoptera made by the late John A. Finzi, has been presented by his widow and daughter, to the Zoological Museum at University College, London.

Professor F. W. Rane was appointed by Governor Foss of Massachusetts, a delegate to the Second International Congress of Entomology at Oxford, England, held last August.

H. Maxwell Lefroy, Entomologist to the Government of India, located at Calcutta, has been appointed Professor of Entomology at the Imperial College of Science and Technology, South Kensington, London.

When Professor A. J. Cook became Commissioner of Horticulture in California a serial publication called "The Monthly Bulletin" was started. The ninth number has just been issued, making altogether 707 pages of interesting and valuable matter.

Mr. Howard Evarts Weed, a member of this association, formerly Entomologist at the Mississippi Agricultural Experiment Station, and now a landscape architect in Chicago, is the author of a book entitled "Modern Park Cemeteries," published by R. J. Haight & Co., Chicago.

Mr. F. W. L. Sladen F. E. S., formerly of Ripple Court Apiary near Dover, England, has been appointed assistant in Apiculture at the Experimental Farms, Ottawa, Can. Mr. Sladen is a practical beekeeper as well as a student of entomology and his work will be under the Dominion Entomologist, Dr. C. Gordon Hewitt.

Dr. W. J. Holland, Director of the Carnegie Museum, Pittsburgh, Pa., Author of "The Butterfly Book" and "The Moth Book" sailed August 20th, for Buenos Aires to install in the National Museum at La Plata, a replica of *Diplodocus carnegiei*, presented by Mr. Carnegie.

Mr. W. S. Fisher, for sometime assistant in the Division of Economic Zoology, Harrisburg, Pa., has recently accepted a position under Dr. A. D. Hopkins, in the Division of Forest Insect Investigations, Bureau of Entomology. Mr. Fisher specializes in the order Coleoptera, and for a time he will be stationed at Charter Oak, Pa., but during the winter will be located at Washington.

Professor T. J. Headlee of the Kansas Agricultural College has been appointed Entomologist of the Agricultural Experiment Station, State Entomologist of New Jersey, and Professor of Entomology at Rutger's College, New Brunswick, N. J., as successor to the late Dr. John B. Smith. Professor Headlee planned to take up his new work about October 1st.

According to *Science* Dr. Henry Fox, professor of biology at Ursinus College, has resigned to accept a position as assistant in the Bureau of Entomology. For the present his headquarters will be at the Experiment Station, Lafayette, Ind.

Rev. Geo. W. Taylor, a collector and writer in entomology, especially Lepidoptera, died at his home near Nanaimo, B. C., August 22. Mr. Taylor was Curator of the Canadian Marine Biological Station at Departure Bay.

It is reported in *Science* that a collection of foreign Lepidoptera containing about 150,000 specimens, included in 68 cabinets and worth over $200,000 has been received at the British Museum as a bequest from the late Mr. H. T. Adams of Enfield.

According to the Monthly Bulletin of the California State Commission of Horticulture, the services of Dr. F. Silvestri of Portici, Italy, have been procured for a period of twelve months, by the Board of Agriculture and Forestry of Hawaii, for the purpose of introducing into the Hawaiian Islands, parasites of the Mediterranean Fruit Fly, *Ceratitis capitata*, and the local Cotton Boll Worm, *Gelechia gossypiella*. Dr. Silvestri will obtain a leave of absence from his present work, and at an early date will visit the tropical portion of West Africa for this purpose. A series of Entomological Stations for receiving and distributing parasitic material will soon be established.

Mr. C. H. T. Townsend removed with his family in June, 1912, from Piura to Lima, Peru, where he becomes chief of the Estacion de Entomologia now being established with headquarters at the capital. The work at Piura will constitute a branch of the station. Mr. E. W. Rust, who has charge of the work in Piura under Mr. Townsend, was unharmed by the severe earthquake which visited that region on the morning of July 24, 1912. The collections, books, notes and important equipment escaped the earthquake, having been transferred to Lima. The Piura office quarters were badly damaged and a transfer is being made to a new temporary site. The equipment left in Piura suffered only nominal damage. Mr. Townsend's correspondents will please note his change of address to Estacion de Entomologia, Lima, Peru.

The following have been appointed members of the Federal Horticultural Board to have charge of the administration of the Plant Quarantine Act: Dr. C. L. Marlatt, Assistant Chief, Bureau of Entomology (Chairman); Dr. W. A. Orton, Plant Pathologist (Vice-Chairman), Peter Bisset, of the Bureau of Plant Industry; A. F. Burgess of the Bureau of Entomology and George B. Sudworth of the Forest Service.

Mailed October 15, 1912.

TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Cleveland, Ohio, January 1–3, 1913

The twenty-fifth annual meeting of the American Association of Economic Entomologists will be held in Cleveland, Ohio, January 1–3, 1913, in the Normal School Building, which is located between Euclid Avenue and East 107th and 115th Streets, four miles east of the center of the city.

The opening session will be called to order at 1 p. m., Wednesday, January 1, when the address of the President of the Association will be delivered. The meeting will be continued Thursday, in the morning and afternoon, and the final session will be held at 10 a. m., Friday, January 3.

Other Meetings

The American Association for the Advancement of Science, and its affiliated societies will hold meetings throughout the week. The Entomological Society of America will meet on Tuesday, December 31, and on Wednesday morning. The public lecture before that Society will be delivered Wednesday evening by Dr. P. P. Calvert of Philadelphia, Pa. The American Association of Official Horticultural Inspectors will meet Thursday evening at 8 p. m., when the Presidential address will be given. The meeting will be continued to Friday afternoon and evening.

Hotel Headquarters

The hotel headquarters for this Association have been secured at Hotel Euclid, which is located at Euclid Avenue, 14th and Huron Streets, in the central part of the city. Rates ranging from $1.50 per day and up for single rooms have been secured on the European plan. Members are urged to make hotel reservations as soon as possible as the number of rooms available at the lower rate are limited.

Railroad Rates

The following information concerning railroad rates has been furnished by Dr. L. O. Howard, permanent secretary of the American Association for the Advancement of Science:

Cleveland is in the territory of the Central Passenger Association. Legislative acts having reduced fares in this territory to the two cents a mile basis, the Central Passenger Association cannot make a further reduction by authorizing the certificate plan of fare-and-three-fifths for the round trip. This means that the certificate plan does not apply for this meeting. It is suggested that advantage be taken of such excursion fares as may be in effect at the time of the meeting. Members should, therefore, consult their local ticket agents regarding routes and rates. Parlor and sleeping car accommodations should be reserved in advance.

From the States of California, Nevada, Oregon, Washington, and west of, and including, Mission Junction, B. C.; also from what are known as Kootenay common points, namely, Nelson, Rossland, Sandon, Kaslo and Grand Forks, B. C., the Transcontinental Passenger Association has on sale daily Nine-Months Tourist fares, approximating two cents per mile in each direction, or about one fare and one third for the round trip. The nine-months fares apply to the eastern gateways of the Transcontinental territory which are:—

Atchison, Kansas.
Chicago, Illinois.
Colorado Springs, Colorado.
Council Bluffs, Iowa.
Denver, Colorado.
Fort Worth, Texas.
Houston, Texas.
Kansas City, Missouri.
Leavenworth, Kansas.
Memphis, Tennessee.
Mineola, Texas.
Minneapolis, Minnesota.
New Orleans, Louisiana.
Omaha, Nebraska.
Pueblo, Colorado.
St. Joseph, Missouri.
St. Louis, Missouri.
St. Paul, Minnesota.

Station agents will cheerfully advise delegates as to the eastern points to which it will be most advantageous for them to purchase nine-months tickets in rebuying through to Cleveland.

Proportionately higher fares are made to principal Atlantic seaboard points and to interior points such as New York, N. Y.; Baltimore, Md.; Philadelphia, Pa.; Washington, D. C.; Boston, Mass.; Montreal, Que.; Albany, N. Y.; Pittsburgh, Pa.; Buffalo, N. Y.; Detroit, Mich.; Toronto, Ont.; Cincinnati, Ohio.; Indianapolis, Ind.; Atlanta, Ga., etc

The nine-months fares do not apply to intermediate or interior points, but only to what are known as the eastern gateways of the Association, such as those named, including also Colorado Common Points. Should it happen that delegates apply at a station on the Pacific Coast from which the nine-months fare is not in effect, which may be the case at very small, unimportant stations, the agent will cheerfully ascertain and advise them the nearest point to his station from which such fare does apply.

Official Buttons

The official button of the Association will be supplied to all members whose dues are paid, including dues for the year 1913. These will be furnished at the meeting on application to the Secretary.

Exhibits

Several members have signified their intention to place on exhibition specimens of insects or breeding apparatus of various kinds. In addition to this the Ohio Agricultural Experiment Station will

make an extensive exhibit of injurious insects in their various stages. This exhibit is used at agricultural fairs and will be of wide educational and practical interest to members and visitors.

Program

Wednesday, January 1, 1.30 p. m

Report of the Secretary.

Report of the executive committee, by President Hunter.

Report of the employment bureau for entomologists, by F. L. Washburn, St. Anthony, Park Minn.

Report of the committee on nomenclature, by Herbert Osborn, chairman, Columbus, Ohio.

Report of the committee on testing proprietary insecticides, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation with agricultural organizations, by F. M. Webster, chairman, Washington, D. C.

Report of the committee on legislation, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation of the Horticultural Inspectors with the American Association of Economic Entomologists, by T. B. Symons, chairman, College Park, Md.

Report of the committee on entomological investigations, by T. J. Headlee, chairman, New Brunswick, N. J.

Appointment of committees.

Miscellaneous business.

Action on proposed amendment to the constitution.

Strike out the first sentence in Article II, Section 1. In the following sentence after the word "entomologists" add "horticultural or apiary inspectors," so that the sentence will read as follows: "All economic entomologists, horticultural, or apiary inspectors employed by the federal or state governments . . . may become members." In Article III, Section 1, omit the last sentence, which provides for the appointment of the membership committee by the President of the Association.

New business.

Annual address of the President, W. D. Hunter, Dallas, Texas.

Reading of Papers

"Further Data on Heat as a Means of Controlling Mill Insects," by George A. Dean, Lawrence, Kans. (10 minutes.)

The temperature required, amount of radiation necessary, and results of heating several large mills.

"Notes on the Rice Water-Weevil, *Lissorhoptrus simplex* Say., and its Control," by Wilmon Newell, College Station, Texas. (15 minutes.)

An account of the writer's observations on this insect in the rice belt of Louisiana during 1909. Notes on feeding habits of adults and larvæ, host plants, longevity, probable number of generations annually, etc. The clue to successful control of the pest by proper manipulation of the irrigating water is pointed out. Use of arsenical poisons for destroying the adults before oviposition is suggested.

"Some Experiments with Roëntgen Rays upon the Cigarette Beetle, *Lasioderma serricorne*," by A. C. Morgan and G. A. Runner, Clarksville, Tenn. (15 minutes.)

"*Schizoneura ulmi* (*fodiens*) distinguished from *Schizoneura lanigera* (*americana*)," by Edith M. Patch, Orono, Maine. (5 minutes.)

Distinctive specific characters are presented for these two aphides both of which curl the leaves of elm; and evidence is cited to show that both species are present in America as well as in Europe.

Adjournment.

Program

Thursday, January 2, 10 a. m.

Discussion of the Presidential Address

Reading of Papers

"New Destructive Insects in New York," by P. J. Parrott, Geneva, N. Y. (12 minutes.)

Brief account of the importance and distribution of a number of species new to the State of New York.

"The Introduction, Methods of Control, and Spread of the Mediterranean Fruit Fly in the Hawaiian Islands, and the Danger of Introducing this Pest into the United States," by Henry H. Severin, Madison, Wis. Lantern. (30 minutes.)

How the Mediterranean Fruit Fly was Introduced into the Hawaiian Islands; the results of experiments in trapping the pest with crude petroleum products, vegetable and animal oils, "Spray and Spraying" and Clean culture; the distribution of the pest in the Hawaiian Islands within two years and the power of flight of two thousand marked male fruit flies; and the danger of introducing the pest into the U. S.

"Organization for Effective Work," by F. W. Rane, Boston, Mass., (10 minutes.)

"A City's attempt to Trap Brown-Tail Moths," by C. H. Hadley, Jr., Durham, N. H. (5 minutes.)

The varying captures at arc light traps. Proportion of males and females.

"Results of Experiments in Controlling the Gipsy Moth by removing its favorite food plants," by A. F. Burgess and D. M. Rogers, Boston, Mass. (15 minutes.)

"Preliminary Review of the Parasites of *Coccus hesperidum* in California," by P. H. Timberlake, Whittier, Cal. (15 minutes.)

A short account of the habits and interrelationship of the different parasites and of their efficiency.

"Some external parasites of domestic fowls," by G. W. Herrick, Ithaca, N. Y. (10 minutes.)

"Some Natural Enemies of Red Spiders," by H. J. Quayle, Berkeley, Cal. (15 minutes.)

An account of the biology and capacity for feeding of representatives of five different Insect Orders.

Adjournment.

Program

Thursday, January 2, 1.30 p. m.

Reading of Papers

"Economic Entomology at the Second International Congress of Entomology," by L. O. Howard, Washington, D. C. (10 minutes.)

"Mosquito Control Work in Connecticut in 1912," by W. E. Britton, New Haven, Conn. Lantern. (10 minutes.)

Brief resumé of educational work, campaigns for raising funds, area drained. Cost of draining and oiling to abolish breeding places.

"Notes on little known habits of the spotted fever tick," by R. A. Cooley, Bozeman, Mont. (12 minutes.)

Attitude assumed while waiting for a host; reaction to passing shadows; sensitiveness to animal breath; avoidance of sunlight.

"Additional Notes on the biology of the Rocky Mountain Spotted fever tick, (*Dermacentor venustus* Banks)," by F. C. Bishopp and W. V. King, Dallas, Texas. (10 minutes.)

Notes on the life history, seasonal history and habits which have been made mainly, since the publication of Bulletin No. 85 of the Montana Experiment Station and Bulletin No. 105 of the Bureau of Entomology, are brought together.

"Pellagra and the Sand-fly II," by S. J. Hunter, Lawrence, Kans. (15 minutes.)

"The Transmission of Infantile Paralysis by *Stomoxys calcitrans*, a résumé of Observations by Brues & Sheppard and Experimental Work by Rosenau & Brues and Anderson & Frost," by C. T. Brues, Forest Hills, Mass. (20 minutes.)

"The Stable Fly, *Stomoxys calcitrans* L., its Bionomics and Life history," by C. Gordon Hewitt, Ottawa, Can. (20 minutes.)

"The Stable Fly, *Stomoxys calcitrans* L., an important Live Stock pest," by F. C. Bishopp, Dallas, Texas. (15 minutes.)

The severe outbreak of this pest in Texas during 1912 is discussed. The importance of the species in other parts of the United States is considered and notes on the life history, habits, natural enemies and methods of control are included.

"Notes on comparative tests with Zinc Arsenite and Arsenate of Lead," by W. J. Schoene, Geneva, N. Y. (5 minutes.)

Includes feeding tests with Insects and effect on foliage.

"Results of the Arsenical Poisoning Investigation," by E. D. Ball, E. G. Titus, and J. E. Greaves, Logan, Utah. (10 minutes.)

Summary of results, effect of arsenicals and alkalies on leaves, on bark, and study of affected regions with suggestions as to real cause of trouble ascribed to above.

"Arsenical Residues on Fruit," by W. C. O'Kane, Durham, N. H. (12 minutes.)

Determinations of the amount of poisons adhering to ripe fruit after spraying; summary of analyses.

"How Contact Insecticides Kill," by G. D. Shafer, East Lansing, Mich. (8 minutes.)

On the influence of Carbon Disulphide and Gasoline vapors upon the activity of Oxidase Extract of Insects.

"Injuries following the application of Petroleum and Petroleum products to Dormant Trees," by E. P. Felt, Albany, N. Y. (15 minutes.)

"The Success of a Two-spray Calendar in a Kansas Orchard," by H. B. Hungerford, Lawrence, Kans. (10 minutes.)

Adjournment.

Program

Friday, January 3, 10 a. m.

READING OF PAPERS

"The Codling Moth and One spraying in the Hudson Valley," by E. P. Felt, Albany, N. Y. (10 minutes.)

"Fall Spraying for the Pear Psylla," by H. E. Hodgkiss, Geneva, N. Y. (10 minutes.)

Results of Experiments to protect pear orchards by fall spraying.

"Peach Stop-back, the work of the Tarnished Plant bug," by Leonard Hasman, Columbia, Mo. (15 minutes.)

Recent outbreaks, life history, food plants and remedies.

"Notes on Three Common Tree Crickets," by P. J. Parrott and B. B. Fulton, Geneva, N. Y. (15 minutes.)

Oviposition, habits and host plants.

"The Sugar Cane Insects of Porto Rico," by D. L. Van Dine, Rio Piedras, P. R. (15 minutes.)

A list, with notes, of the insects affecting sugar cane in Porto Rico.

"The Arrangement of Material in an Entomological Bulletin," by R. L. Webster, Ames, Iowa. (10 minutes.)

This paper considers an arrangement of matter for an entomological bulletin which separates the popular and technical discussion; the first being placed at the front portion of the bulletin, followed by the second.

"Entomological Pioneering in Arizona," by A. W. Morrill, Phoenix, Ariz. (15 minutes.)

Entomological conditions, experiences, observations and prospects in a field new to economic entomology.

"Apparatus for Maintenance of Thermal Climatic Conditions," by S. J. Hunter, Lawrence, Kans. (10 minutes.)

"The Sugar Beet Leaf-Hopper," by E. D. Ball, Logan, Utah. (10 minutes.)

Distribution, amount of damage, method of attack and remedial measures.

"Some Notes on *Laphygma frugiperda* in Porto Rico," by Thomas H. Jones, Rio Piedras, P. R. (10 minutes.)

Notes on occurrence and life history of the species in Porto Rico.

"Recent Studies on the Weevil and Bud Moth of the Walnut and a Saw fly attacking Blackberry," by W. E. Britton, New Haven, Conn. Lantern. (10 minutes.)

Brief presentation of life history and injury of each of these pests, about which little or nothing has previously been known.

"Controlling the Apple Leaf-Hopper in Missouri," by Leonard Haseman, Columbia, Mo. (15 minutes.)

Notes on life history, work of the pest in Missouri and methods of controlling it.

"The Unspotted Tentiform Leaf-miner of the Apple," by Leonard Haseman, Columbia, Mo. (15 minutes.)

Life history, recent outbreaks in Missouri and methods of control.

Final Business Session

Report of committee on auditing.
Report of committee on resolutions.
Report of committee on membership.
Report of other committees.
Report of committee on nominations.
Election of officers.
Miscellaneous business.
Fixing the time and place of the next meeting.
Final adjournment.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

W. D. Hunter, *President*,
Dallas, Texas.